B&R Automation Studio Quick Start

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Chapter 1 − Introduction

B&R AUTOMATION STUDIO™

Quick Start

Version: **2.40 (August 2003)**

We reserve the right to change the contents of this manual without warning. The information contained herein is believed to be accurate as of the date of publication, however, Bernecker + Rainer Industrie−Elektronik Ges.m.b.H. makes no warranty, expressed or implied, with regards to the products or the documentation contained within this book. Bernecker + Rainer Industrie−Elektronik Ges.m.b.H. shall not be liable in the event of incidental or consequential damages in connection with or arising from the furnishing, performance or use of these products.

Introduction

Features

B&R Automation Studio™ provides you with a development system for all automation tasks. B&R Automation Studio™ features:

Features	***Description***
Microsoft Windows Look & Feel	The B&R Automation Studio™ desktop complies with the Microsoft design guidelines for Windows programs. This makes it easier to become familiar with the program and reduces project engineering costs.
Supports Many Target Systems	The B&R Automation Studio™ development environment supports many different target systems. This allows the automation platform to be scaled to meet your exact requirements.
More than IEC 1131	In addition to IEC 1131 languages, B&R Automation Studio™ offers high level language programming using ANSI C and complete line of high performance technology functions which greatly simplify project engineering for your machines and systems.
Startup	All diagnosis and service tools clearly show system behavior using graphic displays. Synchronous recording of data replaces an oscilloscope and allows exact settings to be made for machine parameters.
Contains all Information	B&R has completely integrated all product information that is relevant during the creation and development of your B&R Automation Studio™ projects. Standard help functions provide easy access of all details related to the operation of this tool. Hardware specific data is placed in user−friendly registers.

The most important tools

The following table provides a rough overview of the most important tools in B&R Automation Studio™ and their functionality.

Tools	***Functionality***
Hardware Configuration	Hardware Configuration features: • Automatic recognition of the target system • Graphic display of the target system • Detailed information about the target system • Simple definition of target system profiles • Direct assignment of symbolic variables to physical terminals
Software Configuration	Software Configuration features: • Efficient configuration of the target system • Clear display of project hierarchy • Simple definition of software profiles
Programming Languages	B&R Automation Basic™ ... previously PL2000 C Program ... ANSI C Ladder Diagram ... IEC 1131 Ladder Diagram (abbr.: LAD) Sequential Function Chart ... IEC 1131 Sequential Function Chart (abbr.: SFC) Instruction List ... IEC 1131 Instruction List (abbr.: IL) Structured Text ... IEC 1131 Structured Text (abbr.: ST)
Libraries and Function Blocks	Many standard functions (function blocks) are included in the delivery of B&R Automation Studio™ which are grouped together in various libraries. Each library contains function blocks which can save you a lot of time and effort when creating solutions to standard problems.
Visualization	Using the Visual Components in B&R Automation Studio™, process images and other visualization elements can be created and tested together with the control task. The following tools are integrated: • Picture Editor • Alarm System

Technology Functions	Modular technology plug−ins allow homogenous integration of high performance tools. • Set, analyze and diagnose axis/drive parameters • CNC Editor • Cam Editor
Diagnosis, Service, etc.	• Online variable force • Online variable monitor • Real−time trace • Complete source level debugger with break point, single step, line coverage and disassemble functions • Logbook makes it easy to determine system status • Profiling function − Task and system runtime measurement

What can I find in this manual?

This manual provides you with an introduction to B&R Automation Studio™ allowing you to get started quickly. It will also provide an overview and helpful tips.

Don’t be shocked by the size of this manual! You should only need approx. 1 to 2 hours to work through the most important chapters (Chapter 2 "Installation" and Chapter 3 "The First Steps").

Chapter	***Contents***
Chapter 1	Chapter 1 "Introduction" provides you with general information required to this manual.
Chapter 2	Chapter 2 "Installation" provides you with all of the important information required to install B&R Automation Studio™.
Chapter 3	Chapter 3 "The First Steps" uses examples to introduce you to the functions available in B&R Automation Studio™. If you work through this chapter, you will become familiar with B&R Automation Studio™ and also collect a lot of useful information.
Appendix A	Appendix A "FAQs" provides answers concerning the following topics: • Installation and update of the B&R Automation Runtime™ operating system • Adding or exchanging modules in a project
Appendix B	Appendix B "Key Combinations for Command Calls" contains an overview of all key combination used in B&R Automation Studio™ to directly call commands.

Conventions

In order to be able to find and interpret information quickly and easily in this manual, visual orientation guidelines such as standard text formats and symbols are used. The following conventions are used.

Visual Orientation Guidelines

In this manual, you will continually find the following typographic conventions:

Convention	***Description***
CAPITALS	Directory names, file names, etc. are shown in capitals.
Bold in Upper/Lower Case Letters	Menu items, command names, names of dialog fields, buttons and options are shown in bold.
Bold Italics	Important terms and information are shown in bold italics.
"In Quotation Marks"	All text that has to be entered in fields and references to other sections are shown in quotation marks.
SMALL CAPITALS	Names of keys on your keyboard, e.g. CTRL KEY, ESC KEY, etc.
	Important remarks and tips are shown using this symbol.
	Explanations of new terms are shown using this symbol.

Format of Key Combinations, Sequences

Key combinations and sequences are differentiated as follows:

Key Combinations	***Description***
KEY1+KEY2	A plus (+) between key names means that the first key is held down while the second is pressed.
KEY1, KEY2	A comma (,) between key names means that both keys are pressed and released in sequence.

Where do I find answers to my questions?

Online help

The B&R Automation Studio™ online help can be called at any time, providing you with information concerning the operation and function of B&R Automation Studio™. To start the online help, click on "Help" in the "?" menu.

If you need help for the active window or dialog box, simply press the F1 key.

This manual

In addition to basic information about B&R Automation Studio™, this manual also contains descriptions of often used procedures.

Appendix A "FAQs" contains answers to frequently asked questions and Appendix B "Key Combinations for Calling Commands" contains an overview of all key combinations used in B&R Automation Studio™ to directly call commands.

Service and support

B&R will be there for you when you need information or advice. If you have questions that are not answered in our documentation, get in touch with your service partner at B&R.

Internet / email

B&R can also be reached via Internet under ***http://www.br−automation.com***. This address provides you with information concerning our products and which email addresses you can use to reach us. New program versions and updates are also available on our WWW pages.

Chapter 2 − Installation

Installation

Automation Net System Requirements

The computer on which B&R Automation Net™ is to be installed must meet the following requirements:

PVI Runtime

	Recommended
Operating system	Windows 95/98/ME, Windows NT 4.0, Windows 2000, Windows XP
Software	In Windows 95, at least Windows socket (Winsock) 2.2 is needed
Processor	At least Pentium 166 MHz
RAM	At least 32 MB (depending on the number of process objects)
Hard disk space	At least 10 MB free

PVI Runtime & Server

	Recommended
Operating system	Windows 95/98/ME, Windows NT 4.0 (SP3 for OPC Server) , Windows 2000, Windows XP
Processor	At least Pentium 166 MHz
RAM	At least 64 MB (depending on the number of process objects)
Hard disk space	At least 100 MB free
SOftware	In Windows 95, at least Windows socket (Winsock) 2.2 is needed VB6.0 (PVI Control) MDAC (OPC Server)

Your computer also has to have an open online interface for the connection between your programming device (computer) and the target system (controller). An open interface (COM1 − COM4) or a CAN interface can be used.

System Requirements

The computer on which B&R Automation Studio™ is to be installed must meet the following requirements:

Hardware

	Recommended
Operating System	Windows 98, Windows ME, Windows NT 4.0, Windows 2000, Windows XP
Processor	At least Pentium II 400 MHz
RAM	At least 128 MB
Hard disk space	at least 300 MB free

Graphics	SVGA (800 x 600)

Software

	Requirement
Internet Explorer	e 6.0 (on the "AS Tools" CD)
.NET Framework	V1.1 (on the "AS Tools" CD in the "DOTNET_FW" directory)

Your computer also has to have an open online interface for the connection between your programming device (computer) and the target system (controller). An open interface (COM1 − COM4) or a CAN interface can be used.

Installing B&R Automation Net

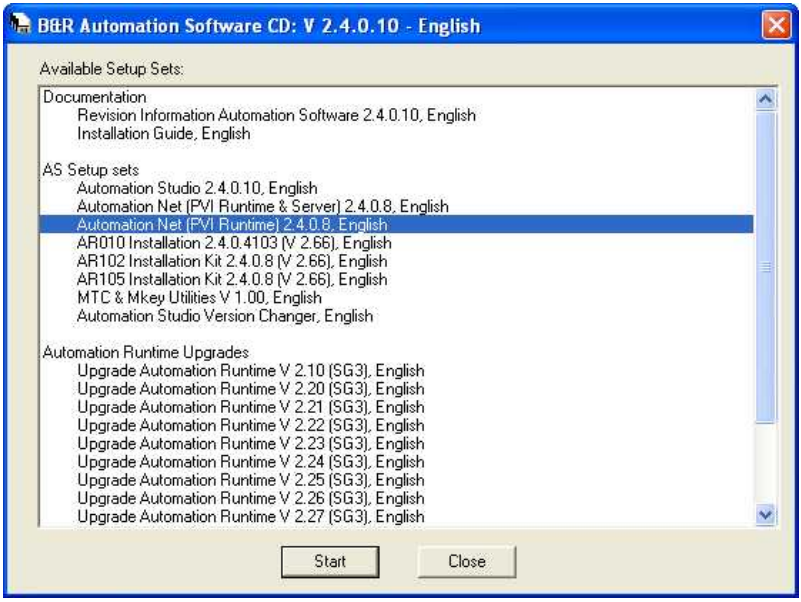
Note:
You need Administrator rights to install software with the Windows NT/2000/XP operating system! Contact your network administrator if necessary.

1. Start your operating system.
2. Place the language−specific installation CD in the CD−ROM drive on your computer.
3. If the "AutoPlay" option is activated on your computer, the B&R Automation Installation window will appear. If "AutoPlay" is not enabled, run the **BrMenu.exe** file from the root directory of your installation CD.

Note:
Automation Net™ represents the foundation for communication and must therefore be the first component installed on your computer.

If a current version of Automation Net has already been installed on your system, this procedure can be skipped.

To install the minimum version, select the "Automation Net (PVI Runtime)" entry in the "B&R Automation Installation" dialog box (BrMenu.exe). If you need PVI Controls, PVI Transfer, and various servers or examples, select "Automation Net (PVI Runtime & Server)".


B&R Automation Software CD: V 2.4.0.10 - English
Available Setup Sets:
Documentation
Revision Information Automation Software 2.4.0.10, English
Installation Guide, English
AS Setup sets
Automation Studio 2.4.0.10, English
Automation Net (PVI Runtime & Server) 2.4.0.8, English
Automation Net (PVI Runtime) 2.4.0.8, English
AR010 Installation 2.4.0.4103 (V 2.66), English
AR102 Installation Kit 2.4.0.8 (V 2.66), English
AR105 Installation Kit 2.4.0.8 (V 2.66), English
MTC & Mkey Utilities V 1.00, English
Automation Studio Version Changer, English
Automation Runtime Upgrades
Upgrade Automation Runtime V 2.10 (SG3), English
Upgrade Automation Runtime V 2.20 (SG3), English
Upgrade Automation Runtime V 2.21 (SG3), English
Upgrade Automation Runtime V 2.22 (SG3), English
Upgrade Automation Runtime V 2.23 (SG3), English
Upgrade Automation Runtime V 2.24 (SG3), English
Upgrade Automation Runtime V 2.25 (SG3), English
Upgrade Automation Runtime V 2.26 (SG3), English
Upgrade Automation Runtime V 2.27 (SG3), English
Start
Close

Installation begins by pressing the **Start** button.

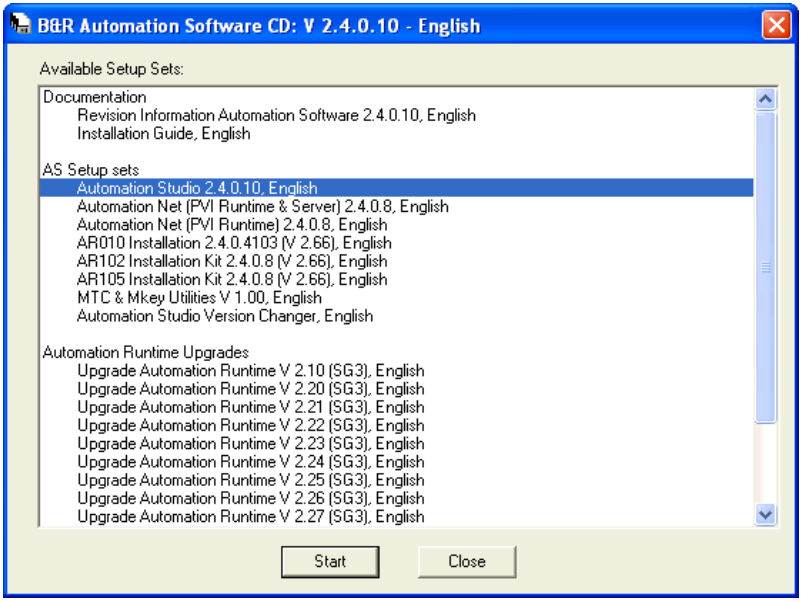
B&R Automation Studio can then be installed once this procedure has been carried out. This is installed to its own version−specific directory tree.

Installing B&R Automation Software

Note:
You need Administrator rights to install software with the Windows NT/2000/XP operating system! Contact your network administrator if necessary.

To install Automation Studio, you must first install Automation Net eV2.3.0.1, Internet Explorer eV6.0 and .NET Framework eV1.1. If these are not installed, Automation Studio installation is cancelled with a message indicating the versions/software necessary.

1. Start your operating system.
2. Place the language−specific installation CD in the CD−ROM drive on your computer.
3. If the "AutoPlay" option is activated on your computer, the B&R Automation Installation window will appear. If "AutoPlay" is not enabled, run the **BrMenu.exe** file from the root directory of your installation CD.


B&R Automation Software CD: V 2.4.0.10 - English
Available Setup Sets:
Documentation
Revision Information Automation Software 2.4.0.10, English
Installation Guide, English
AS Setup sets
Automation Studio 2.4.0.10, English
Automation Net (PVI Runtime & Server) 2.4.0.8, English
Automation Net (PVI Runtime) 2.4.0.8, English
AR010 Installation 2.4.0.4103 (V 2.66), English
AR102 Installation Kit 2.4.0.8 (V 2.66), English
AR105 Installation Kit 2.4.0.8 (V 2.66), English
MTC & Mkey Utilities V 1.00, English
Automation Studio Version Changer, English
Automation Runtime Upgrades
Upgrade Automation Runtime V 2.10 (SG3), English
Upgrade Automation Runtime V 2.20 (SG3), English
Upgrade Automation Runtime V 2.21 (SG3), English
Upgrade Automation Runtime V 2.22 (SG3), English
Upgrade Automation Runtime V 2.23 (SG3), English
Upgrade Automation Runtime V 2.24 (SG3), English
Upgrade Automation Runtime V 2.25 (SG3), English
Upgrade Automation Runtime V 2.26 (SG3), English
Upgrade Automation Runtime V 2.27 (SG3), English
Start
Close

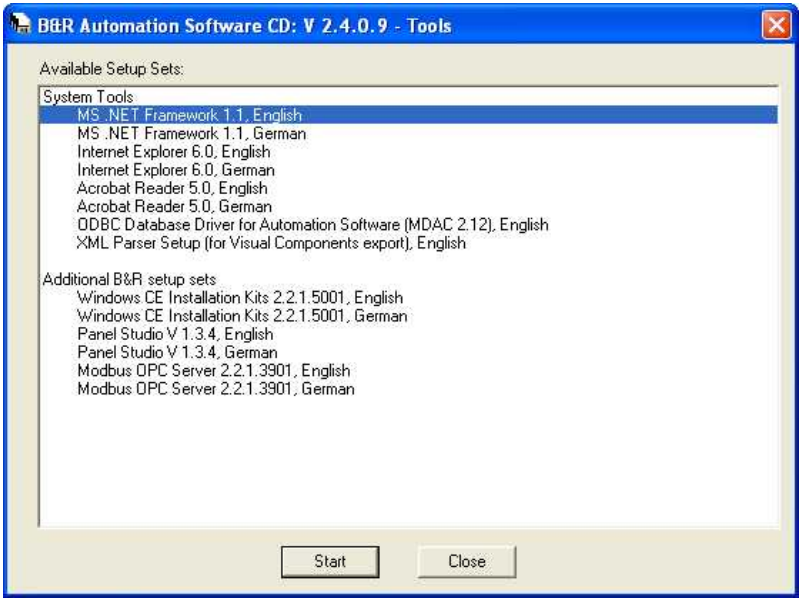
Choose the desired entry with the cursor keys and then begin the installation by pressing the **Start** button.

Data is then installed to its own version−specific directory tree.

Installing .NET Framework

If .NET Framework isn't installed on your system yet, it can be done as follows:

1. Place the "AS Tools" installation CD in the CD−ROM drive on your computer.
2. If the "AutoPlay" option is activated on your computer, the B&R Automation Installation window will appear. If "AutoPlay" is not enabled, run the **BrMenu.exe** file from the root directory of your installation CD.


B&R Automation Software CD: V 2.4.0.9 - Tools
Available Setup Sets:
System Tools
MS .NET Framework 1.1, English
MS .NET Framework 1.1, German
Internet Explorer 6.0, English
Internet Explorer 6.0, German
Acrobat Reader 5.0, English
Acrobat Reader 5.0, German
ODBC Database Driver for Automation Software (MDAC 2.12), English
XML Parser Setup (for Visual Components export), English
Additional B&R setup sets
Windows CE Installation Kits 2.2.1.5001, English
Windows CE Installation Kits 2.2.1.5001, German
Panel Studio V 1.3.4, English
Panel Studio V 1.3.4, German
Modbus OPC Server 2.2.1.3901, English
Modbus OPC Server 2.2.1.3901, German
Start
Close

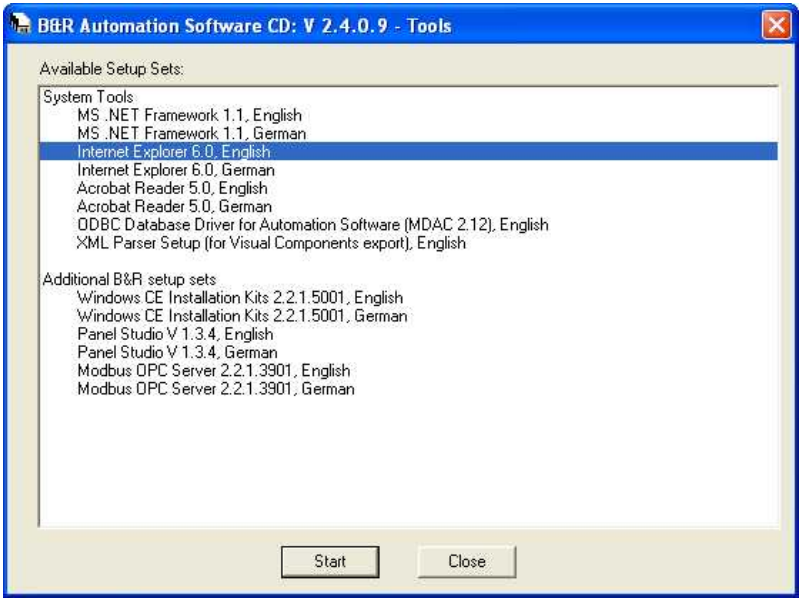
Choose the desired language for .NET Framework with the cursor keys and then begin the installation by pressing the **Start** button. The entire installation is menu driven. Installing Automation Software can continue once the installation is completed successfully.

Installing Microsoft Internet Explorer

Note:
If Microsoft Internet Explorer version 6.0 (or higher) is already installed on your computer, then you can skip the following steps and proceed instead to the Automation Software installation.

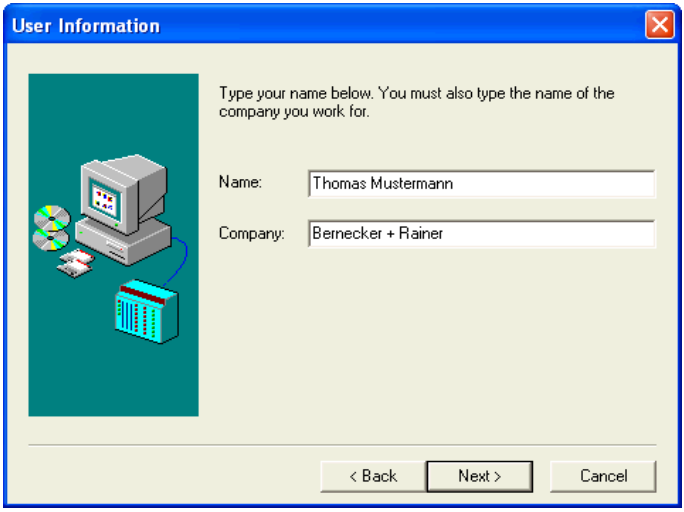
You need Administrator rights to install software with the Windows NT/2000/XP operating system! Contact your network administrator if necessary.

1. Start your operating system.
2. Place the "AS Tools" installation CD in the CD−ROM drive on your computer.
3. If the "AutoPlay" option is activated on your computer, the B&R Automation Installation window will appear. If "AutoPlay" is not enabled, run the **BrMenu.exe** file from the root directory of your installation CD.


B&R Automation Software CD: V 2.4.0.9 - Tools
Available Setup Sets:
System Tools
MS .NET Framework 1.1, English
MS .NET Framework 1.1, German
Internet Explorer 6.0, English
Internet Explorer 6.0, German
Acrobat Reader 5.0, English
Acrobat Reader 5.0, German
ODBC Database Driver for Automation Software (MDAC 2.12), English
XML Parser Setup (for Visual Components export), English
Additional B&R setup sets
Windows CE Installation Kits 2.2.1.5001, English
Windows CE Installation Kits 2.2.1.5001, German
Panel Studio V 1.3.4, English
Panel Studio V 1.3.4, German
Modbus OPC Server 2.2.1.3901, English
Modbus OPC Server 2.2.1.3901, German
Start
Close

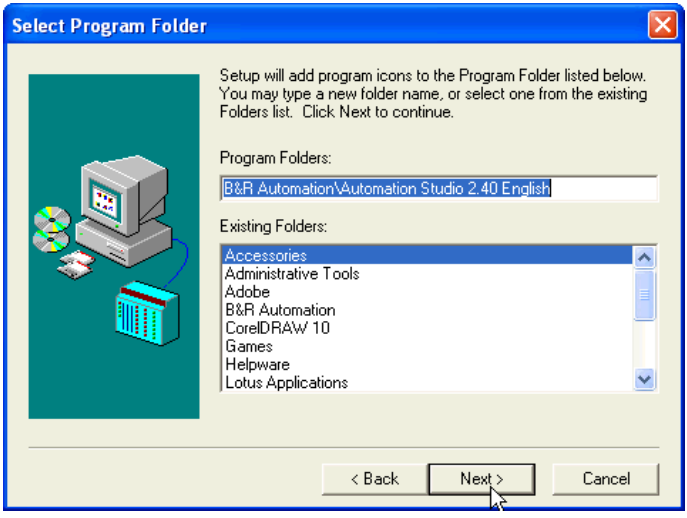
Choose the desired language for Internet Explorer with the cursor keys and then begin the installation by pressing the **Start** button. The entire installation is menu driven. If the installation was successful, restart your computer so that all settings can be applied.

User Information



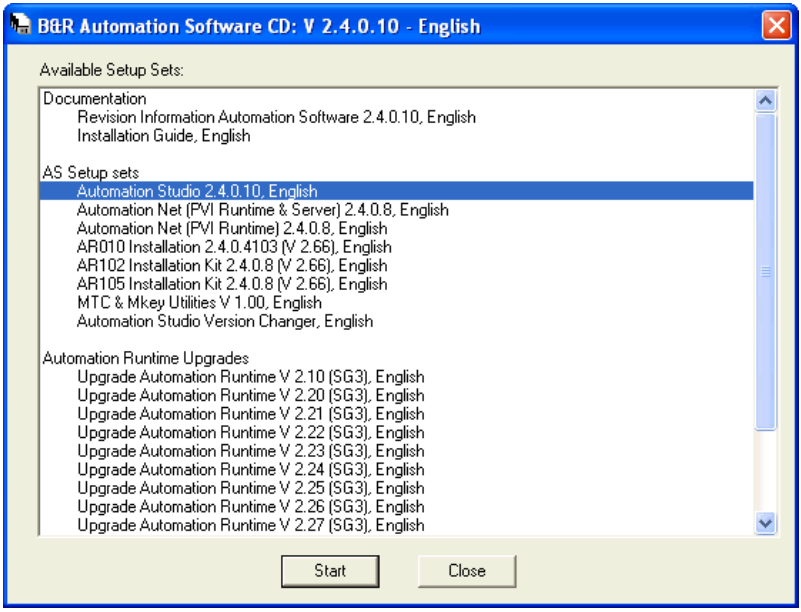
Insert User and Company name and continue with **Next** − Button.

Program Folder Definition



If the entries are confirmed, a new program folder will be made. If you agree with the default folder name press NEXT button, otherwise enter a new name.

Selecting Software Components


B&R Automation Software CD: V 2.4.0.10 - English
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Automation Net (PVI Runtime) 2.4.0.8, English
AR010 Installation 2.4.0.4103 (V 2.66), English
AR102 Installation Kit 2.4.0.8 (V 2.66), English
AR105 Installation Kit 2.4.0.8 (V 2.66), English
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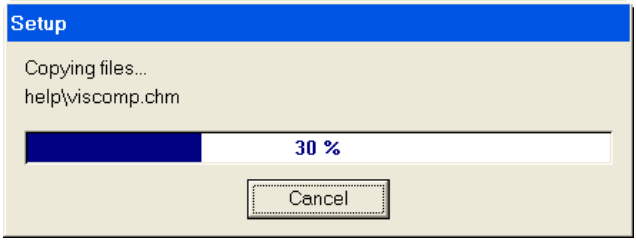
Upgrade Automation Runtime V 2.21 (SG3), English
Upgrade Automation Runtime V 2.22 (SG3), English
Upgrade Automation Runtime V 2.23 (SG3), English
Upgrade Automation Runtime V 2.24 (SG3), English
Upgrade Automation Runtime V 2.25 (SG3), English
Upgrade Automation Runtime V 2.26 (SG3), English
Upgrade Automation Runtime V 2.27 (SG3), English
Start
Close

Choose the software components which you would like to install and then press the **Next >** button.

The archive file is now unpacked and copying begins.

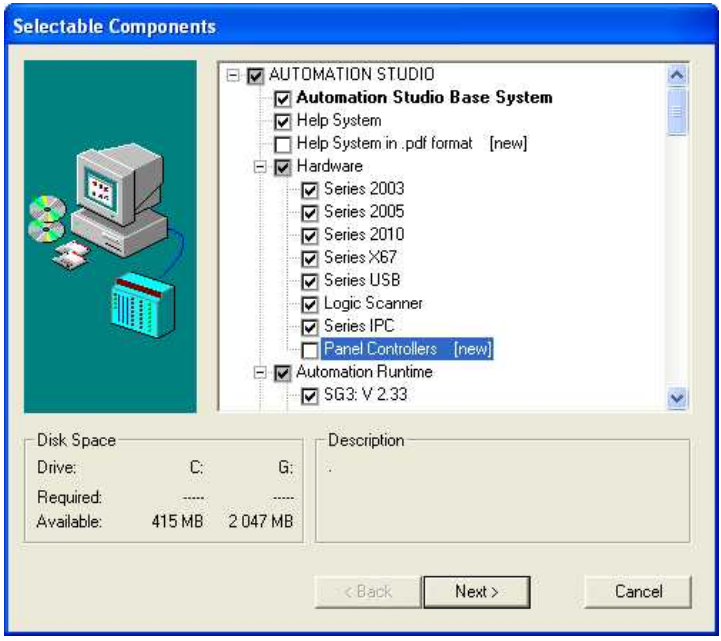


Progress for the copying procedure is displayed on the screen.

When the installation is complete, you will be asked to register your copy of B&R Automation Studio™.

Adding/Installing Software Components

If the Setup program is started on a system which already has Automation Studio installed, all of the components which can be installed are shown in a component tree. Components which have not already been installed on the system are identified with **[new]**.

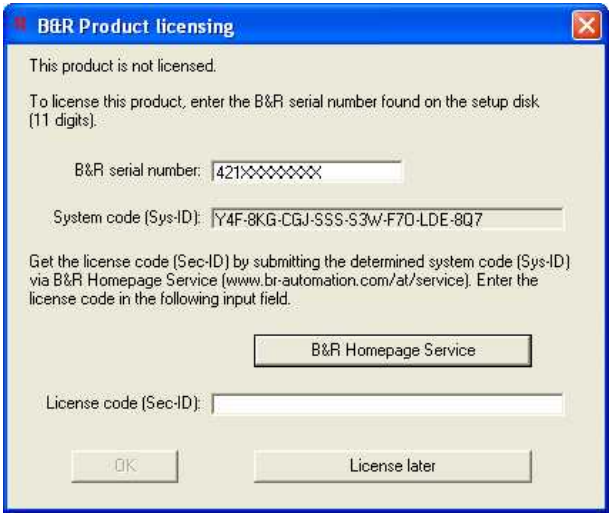


Mark (check) the components that should be installed on the system.

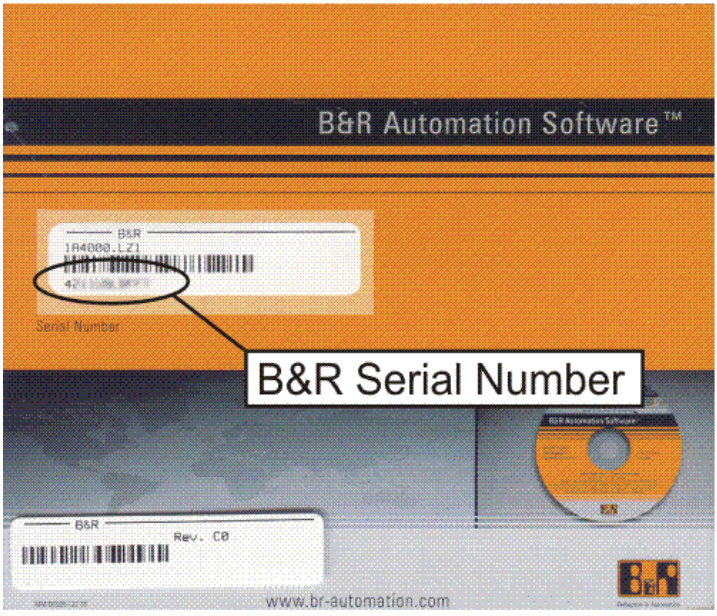
Warning:
If check marks are removed from the component tree, this automatically means that you would like to **deinstall** those components.

Licensing

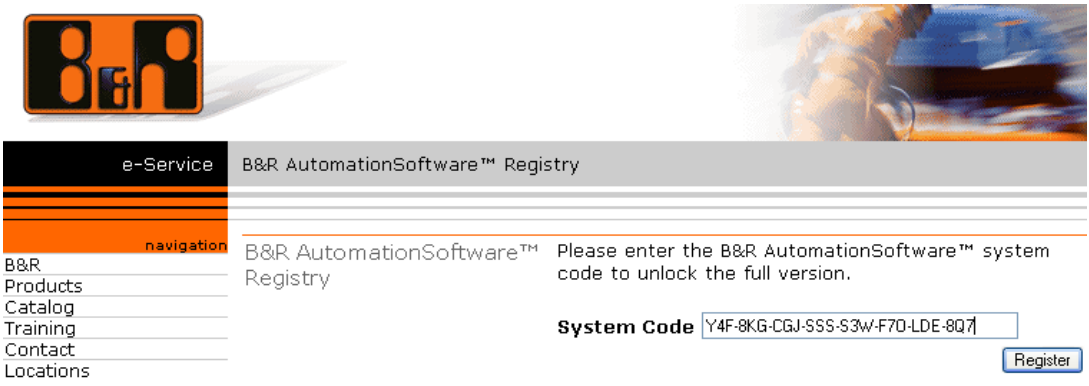
If the B&R Automation Studio is not jet licensed, following dialog is displayed:


B&R Product licensing
This product is not licensed.
To license this product, enter the B&R serial number found on the setup disk (11 digits).
B&R serial number: 421XXXXXXXX
System code (Sys-ID): Y4F-8KG-CGJ-SSS-S3W-F7O-LDE-8Q7
Get the license code (Sec-ID) by submitting the determined system code (Sys-ID) via B&R Homepage Service (www.br-automation.com/at/service). Enter the license code in the following input field.
B&R Homepage Service
License code (Sec-ID):
OK
License later

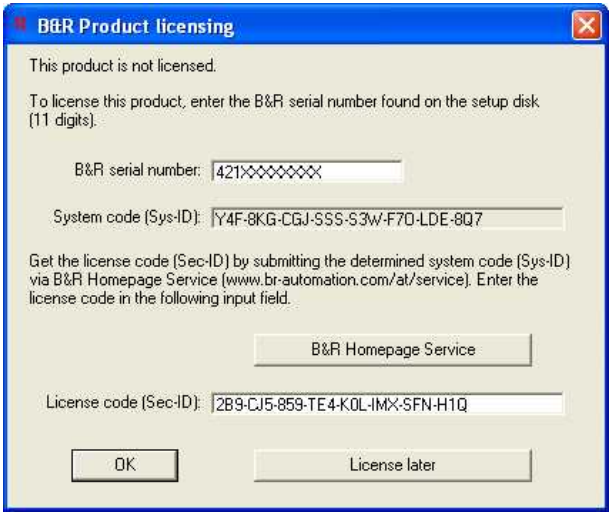
Enter the supplied serial number (from the back side of the CD Cover 1A4000.LZ1 or 1A4000.LZU)



A system code will be calculated, with this code enter into B&R Homepage Service (e−service) to get the License code.



Enter this code in field (License code [Sec−ID]).


B&R Product licensing
This product is not licensed.
To license this product, enter the B&R serial number found on the setup disk (11 digits).
B&R serial number:
421XXXXXXX
System code (Sys-ID):
Y4F-8KG-CGJ-SSS-S3W-F7O-LDE-8Q7
Get the license code (Sec-ID) by submitting the determined system code (Sys-ID) via B&R Homepage Service (www.br-automation.com/at/service). Enter the license code in the following input field.
B&R Homepage Service
License code (Sec-ID):
2B9-CJ5-859-TE4-K0L-IMX-SFN-H1Q
OK
License later

If the code is correct you can exit the licensing with the **OK** button

If no valid B&R serial number is entered, you can exit with the "License later" button to start an evaluation period of 30 days.

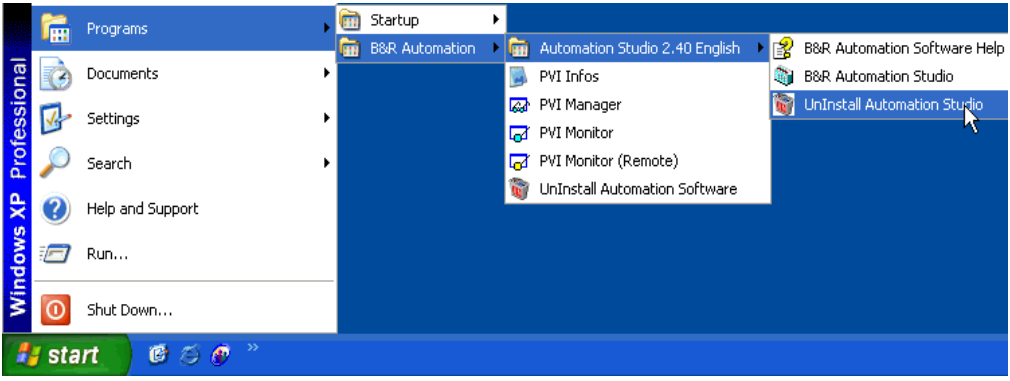
The evaluation time will be displayed at the start of Automation Studio. During this time B&R Automation Studio has no restriction.

If the evaluation time is expired, the software must be licensed, otherwise you can not start the B&R Automation Studio anymore.

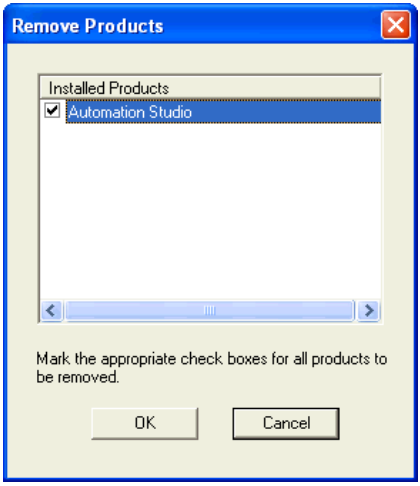
Uninstalling B&R Automation Software

Note:
If there are several version of B&R Automation Studio™ being used on your computer simultaneously, only the **active** version can be uninstalled. If no versions are active, the Version Changer can be used to activate the one you want to uninstall (see Version Changer help).

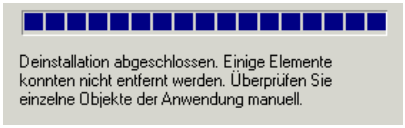
If you want to remove B&R Automation Software™ from your hard drive, proceed as shown in the following picture:



If the Uninstall Wizard is started, then you have the possibility to choose which program(s) to remove in the next dialog box.



However, if the uninstall finished with an error message (see following dialog box), then the removal of any remaining unused files has to be done manually.

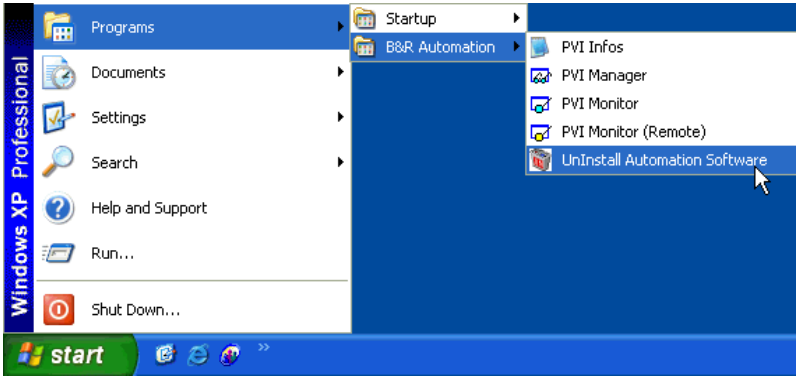

Deinstallation abgeschlossen. Einige Elemente konnten nicht entfernt werden. Überprüfen Sie einzelne Objekte der Anwendung manuell.

Applies to multiple installations:
If there is still a B&R Automation Studio™ version present on your computer after one has been uninstalled, it has to be activated using the Version Changer.

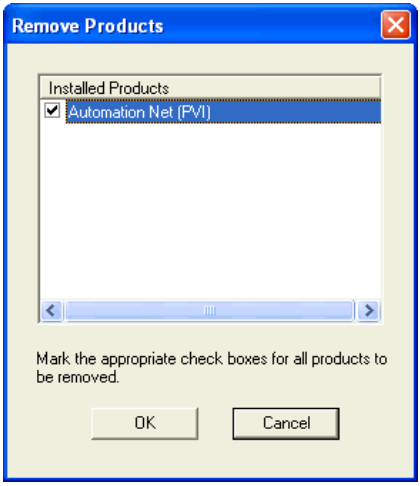
Uninstalling B&R Automation Net™ (PVI)

Before B&R Automation Net™ (PVI) can be uninstalled, all B&R Automation Studio™ versions need to be uninstalled beforehand.

If you want to remove B&R Automation Net™ (PVI) from your hard drive, proceed as shown in the following picture:



If the Uninstall Wizard is started, then you have the possibility to choose which program(s) to remove in the next dialog box.



Uninstallation of the selected components begins when the **OK** button is clicked.

Chapter 3 − First Steps

The first program start

The installation is divided into 2 sections:

B&R Automation Net(PVI) Installation

B&R Automation Studios™ Installation

In the following sections of this chapter, we will assume that the following settings were entered during the installation of B&R Automation Studio™:

B&R Automation Net(PVI) Installation

Path to target directory for the installation:

C:\BrAUTOMATION

Name of the B&R Automation Studio™ program group:

B&R AUTOMATION

B&R Automation Studio™ Installation

Path to target directory for the installation:

C:\BR_AS_XXX_L0XX (e.g. C:\BR_AS_220_L001)

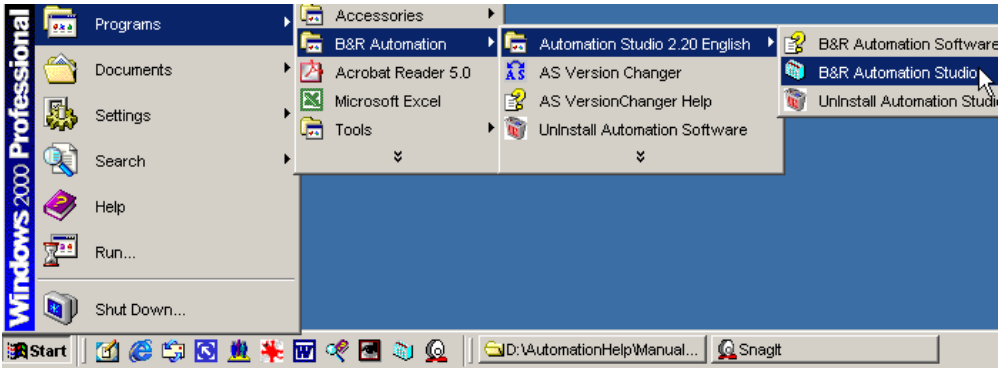
Name of the B&R Automation Studio™ program group:

AUTOMATION STUDIO X.XX English

Start B&R Automation Studios

B&R Automation Studios™ is started as follows:

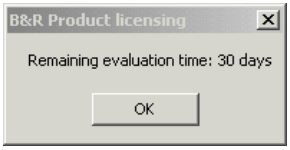
- Click on the ***Start*** button and go to the program menu.
- Go to the folder B&R Automation and start the program B&R Automation Studio:



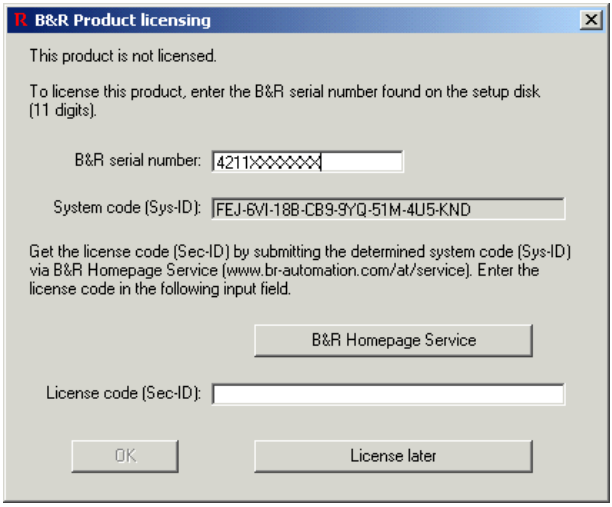
After starting B&R Automation Studio™, the start screen is shown for a short time and then B&R Automation Studio™ is opened.

Starting an Evaluation Version

If B&R Automation Studio™ has not been licensed, it can only be run for 30 days. The remaining evaluation period is shown each time B&R Automation Studio™ is started. Operation is possible during this period without limitations.



The licensing dialog box is opened by clicking on the OK button. You can either license the software or open the evaluation version by clicking on the License later.


B&R Product licensing
This product is not licensed.
To license this product, enter the B&R serial number found on the setup disk (11 digits).
B&R serial number:
4211XXXXXXX
System code (Sys-ID):
FEJ-6VI-18B-CB9-9YQ-51M-4U5-KND
Get the license code (Sec-ID) by submitting the determined system code (Sys-ID) via B&R Homepage Service (www.br-automation.com/at/service). Enter the license code in the following input field.
B&R Homepage Service
License code (Sec-ID):
OK
License later

After the 30 days have passed, B&R Automation Studio™ can no longer be started. "Evaluation ended" is shown. The licensing dialog box is opened by clicking on the OK button. For more information see "Chapter 1 −> Installation −> Licensing".

Start screen

B&R Automation Studio

B&R Automation Studio™ Window:

No.	*Name*	*Description*
1	Main menu	The B&R Automation Studio™ main menu changes according to the active editor. In this way, you can select from the functions needed for the active editor.
2	Toolbar	Contains toolbar icons that provide fast access to various commands and functions. If you place the mouse pointer over the icons, the name is shown. Use the Toolbars... command in the View menu to show or hide toolbars
3	Program Workspace	The window for an open project is shown in this area. This window can be maximized in this area for sized as required.
4	Message Window	The message window is shown in the lower part of the program window after the first time B&R Automation Studio™ is started. The message window shows e.g. compiler and debugger messages.
5	Status line	The status bar at the bottom of the window shows information such as: • Short help information for menu commands or tool bar icons.

		• Short information concerning editing procedures. • Current position in a list, tree or text • Status of the online connection between the programming device and the target system (see "Chapter 3 −> How to create a project? −> Creating a New Project"). • Status of the target system (RUN, STOP, DIAG) • Status of various keys (CapsLock, Num, Scroll)

Exiting B&R Automation Studio

Exit B&R Automation Studio™, by ...

... clicking on Exit in the File menu, or

... clicking on the button in the top right corner of the B&R Automation Studio™ window.

Keyboard and mouse operation

The B&R Automation Studio™ desktop complies with the Microsoft design guidelines for Windows programs. That means keyboard and mouse operation also correspond to the Windows standard. If you have already worked with Windows, you will be able to find your feet quickly in B&R Automation Studio™.

Additional information concerning the operation of B&R Automation Studio™ can be found in the online help. To start the online help, click on "Help" button in the "?" menu or press F1.

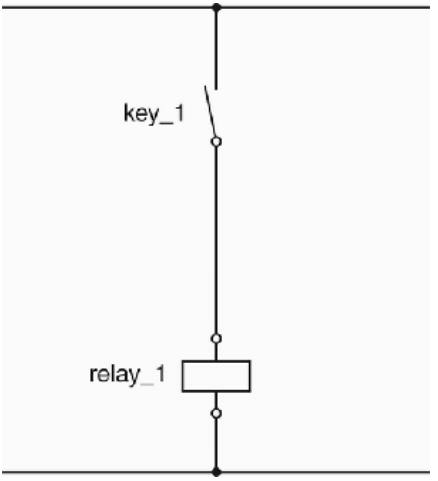
Appendix B −> "Key Combinations for Command Calls" contains an overview of all key combination used in B&R Automation Studio™ to directly call commands.

Example Program

In the following sections, we will get the ball rolling by writing a short example program in B&R Automation Studio™ using the ladder diagram (LAD) programming language.

Task description

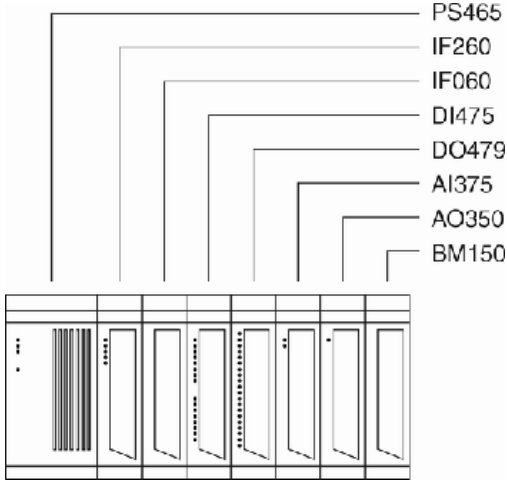
We will create a project called "AS_QS" in directory "D:\PROJECTS". Then we will open the project and enter the circuit plan shown in the following illustration using LAD.



This example program be saved in the project "AS_QS" under the name "logic1".

Hardware requirements

In this manual, the following hardware is used as the target system for all example programs:



PS465	Power supply module
IF260	CPU
IF060	Interface module
DI475	Digital input module
DO479	Digital output module
AI375	Analog input module
AO350	Analog output module
BM150	Dummy module (to fill unused slots)

Many pictures and information in the following sections refer to this hardware configuration. However, you can also use different hardware. To run this example program, you will need at least the following hardware components:

- Power supply module
- CPU
- Digital input module
- Digital output module

Without the hardware components listed above, you can program the example but you can’t test it.

How to create a project?

A project contains all information for a system/machine, including all programs and the corresponding data banks. In order to be able to enter an example program, you have to create a project.

Preparation

B&R Automation Studio™ is a hardware oriented programming system. That means the hardware has to be defined when creating a project. B&R Automation Studio™ can carry out automatic hardware recognition when creating a project. For inexperienced users, this is the simplest type of hardware definition.
The online connection has to be configured properly so that B&R Automation Studio™ can determine the hardware configuration on the target system. Before creating a project, check the connection between the programming device (computer) and target system (controller).

To establish an online connection, the B&R Automation Runtime™ Operating System must be installed on your target system.

B&R Automation Runtime™ is an adjustable, deterministic real−time multitasking operating system.

With the exception of the B&R SYSTEM 2010 CPUs (CP10x and CP2x0), B&R delivers all processor modules with the B&R Automation Runtime™ operating system preinstalled.

When using a new B&R SYSTEM 2010 application memory, the operating system is not yet installed. If the operating system is not installed, and operating system download has to be carried out. An exact description of this procedure can be found in Appendix A "FAQs", Section "1 How do I install the operating system?".

How to make a connection between the programming device and PCC?

The connection between the programming device and controller is made using an online cable (***Model No.: 0G0001.00−090***).

Take note of the following points when making an online connection using this cable:

- COM1, COM2, COM3 or COM4 has to be free on your computer.
- The online cable has two 9 pin D−type sockets. The serial interfaces on some computer use a 25 pin D−type plugs, therefore you might need an

adapter. These type of adapters are often included with a mouse. Otherwise you can get an adapter from a local supplier.
- The online cable is only for a connection between two RS232 interfaces. Do not use an adapter to connect the serial interface COMx with an RS485/RS422 interface. You need a special interface converter to do this!

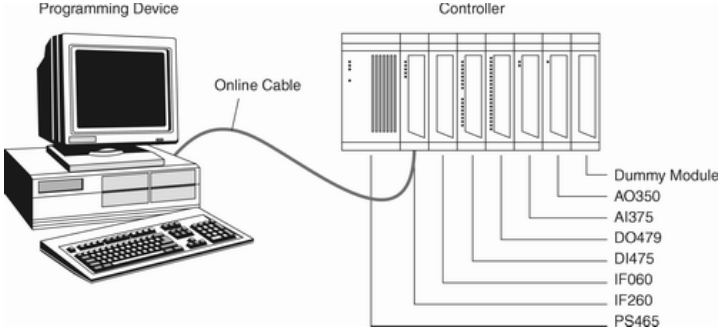
The communication can also take place using an ETHERNET interface. The CAN interface on B&R Industrial PCs can also be used as online interface.

When using a LS251 Logic Scanner CPU, the online connection is made via the PCI Bus and SRAM on the LS251.

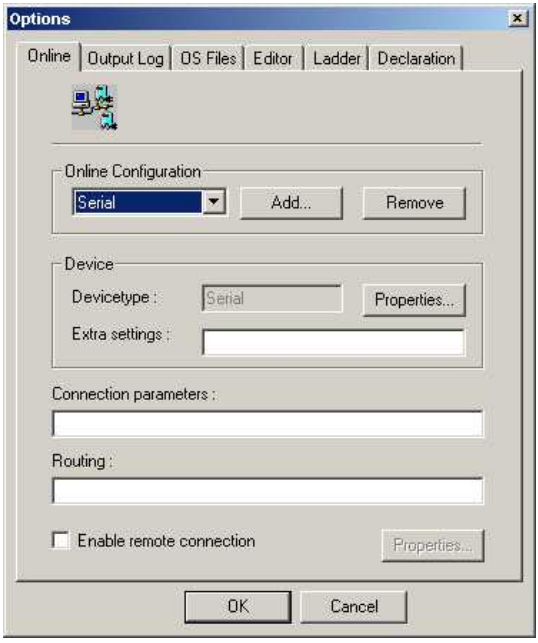
Establishing the online connection

In our example, communication with the controller should take place via the COM2 serial interface on the programming device.

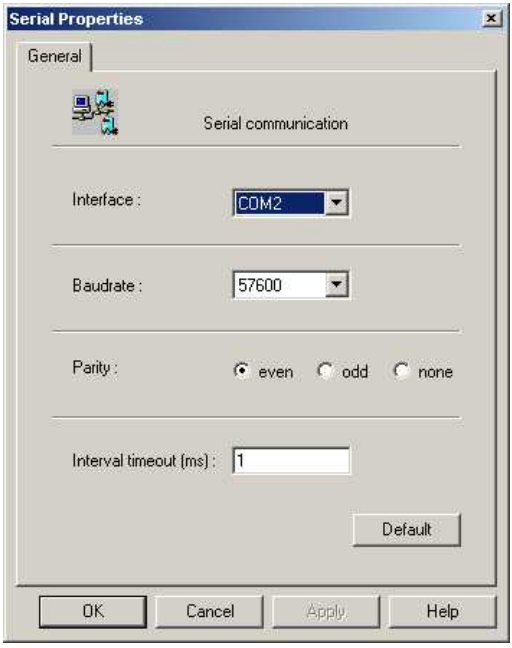
Before the programming device and the controller are connected with each other, make sure that the controller is turned on (is power applied?). Then take the online cable and connect the RS232 interface on the CPU with the serial interface COM2 on the programming device:



After this is done, the online connection has to be configured. To do this, select **Options...** from the Tools menu in B&R Automation Studio™. The online interface can be configured in the dialog box shown.



After installing B&R Automation Studio™, the serial interface COM2 is selected as default. To change the configuration of the interface, click on the **Properties** button. The settings can be changed in the Serial **Properties** dialog box. For our example, we will not change the standard settings.



Descriptions for other settings in the Options dialog box can be found in the online help. The defined parameters are accepted when this dialog box is closed by pressing the OK button.

If the online interface is configured correctly, the online connection between the programming device and the controller will be established automatically when the project is opened (see "Chapter 3 −> How to create a project? −> Creating a New Project").

Creating a New Project

B&R Automation Studio™ is a hardware oriented programming system. That means the hardware has to be defined when creating a project. We differentiate between Automatic Hardware Recognition and Manual Hardware Definition.

Automatic Hardware Recognition

B&R Automation Studio™ can carry out automatic hardware recognition when creating a project. For inexperienced users, this is the simplest type of hardware definition.

To create a new project, select the New Project... command from the File menu. Then the New Project Wizard is opened. In this dialog box, you can enter the desired project name (Name) and the path to the project directory (Path). For our example project, we will use the project name "AS_QS" and the project should be saved in the "D:\PROJECTS" directory:

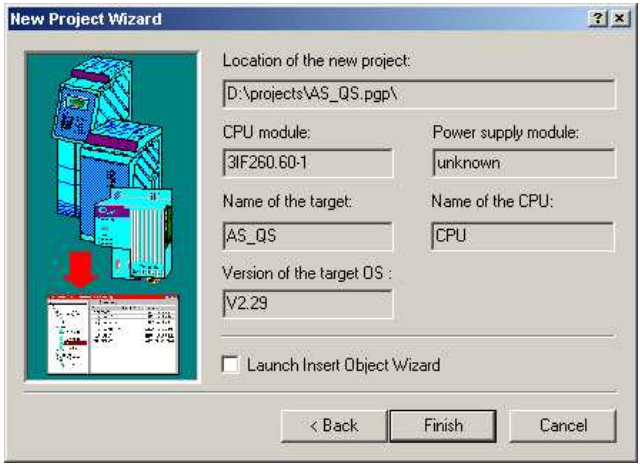
New Project Wizard
Automation Studio will guide you step by step through creating a new project. First of all enter a name and a path for the project.
Name:
AS_QS
Path:
D:\projects
Browse...
Target:
AS_QS
If you want Automation Studio to upload an existing configuration please make sure that the target is connected to the computer.
Upload hardware from target
Next >
Cancel

If you want to use a project name other than "AS_QS", read the limitations for project names given in context sensitive help!

In order to be able to upload the hardware configuration from the controller automatically (automatic hardware recognition), select **Upload hardware from target**!

If the directory "D:\PROJECTS" doesn't exist, you will be asked if it should be created when you press the **Next >** button. Answer this question with OK.

B&R Automation Studio™ then carries out automatic hardware recognition. The progress is shown in a dialog box. When the hardware recognition is complete, you can open the next dialog box by clicking on **Next >**:



This dialog box shows all previously defined data along with the CPU found during hardware recognition. Power supplies do not have a hardware code, therefore they cannot be automatically recognized by B&R Automation Studio™. They can be added to the **hardware configuration** manually later (see "Appendix A −> How can I work without hardware?").

Check the data again. You can go back and correct data by clicking on **< Back**. If the data is correct, click on **Finish** to create and open the project.

Manual Hardware Definition

Manual hardware definition is mostly used when the target system is not available. The following section describes the procedure for project creation using manual hardware definition.

To create a new project, select the New Project... command from the File menu. Then the New Project Wizard is opened. In this dialog box, you can enter the desired project name (Name) and the path to the project directory (Path). For our example project, we will use the project name "AS_QS" and the project should be saved in the "D:\PROJECTS" directory:

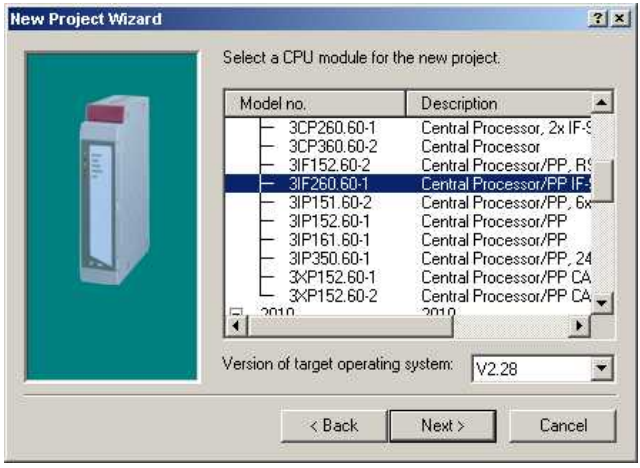
New Project Wizard
Automation Studio will guide you step by step through creating a new project. First of all enter a name and a path for the project.
Name:
AS_QS
Path:
D:\projects
Browse...
Target:
AS_QS
If you want Automation Studio to upload an existing configuration please make sure that the target is connected to the computer.
Upload hardware from target
Next >
Cancel

If you want to use a project name other than "AS_QS", read the limitations for project names given in context sensitive help!

For manual hardware definition, **Upload hardware from target** has to be deactivated!

If the directory "D:\PROJECTS" doesn't exist, you will be asked if it should be created when you press the **Next >** button. Answer this question with OK.

Then you have to define the CPU on the target system. A list of all possible modules is shown:



Select the desired CPU from the list and then click on **Next >**. Another dialog box is then opened where you can select from a list of all power supply modules that can be used with for the selected CPU. Select the desired power supply and then click on **Next >**. The next dialog box shows all previously defined data and the modules defined manually (model number of the CPU and power supply modules):

New Project Wizard
Automation Studio will guide you step by step through creating a new project. First of all enter a name and a path for the project.
Name:
AS_QS
Path:
D:\projects
Browse...
Target:
AS_QS
If you want Automation Studio to upload an existing configuration please make sure that the target is connected to the computer.
Upload hardware from target
Next >
Cancel

Check the data again. You can go back and correct data by clicking on **< Back**. If the data is correct, click on Finish to create and open the project.

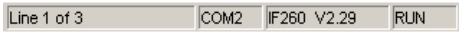
During manual hardware definition, only the CPU and power supply modules are defined. All other modules (e.g. digital or analog I/O modules) have to be set after manual hardware definition. A detailed description of this procedure can be found in Appendix A −> How can I work without hardware?.

Connection status

If the online interface is configured correctly, the Online Connection between the programming device and the target system is established automatically when a project is opened. The connection status is shown in the status bar:

Active Connection

Active connection between programming device and target system:

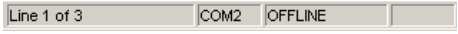


The text in the status bar contains the following information:

Status Bar	***Information***
COM2	Shows the interfaced used on the computer as online interface.
IF260 V2.29	Shows the processor type (name of the CPU) and the operating system version used.
RUN	Mode that the processor is in: RUN = RUN Mode SERV = SERVICE Mode DIAG = DIAGNOSE Mode

No Connection

No connection between programming device and target system:

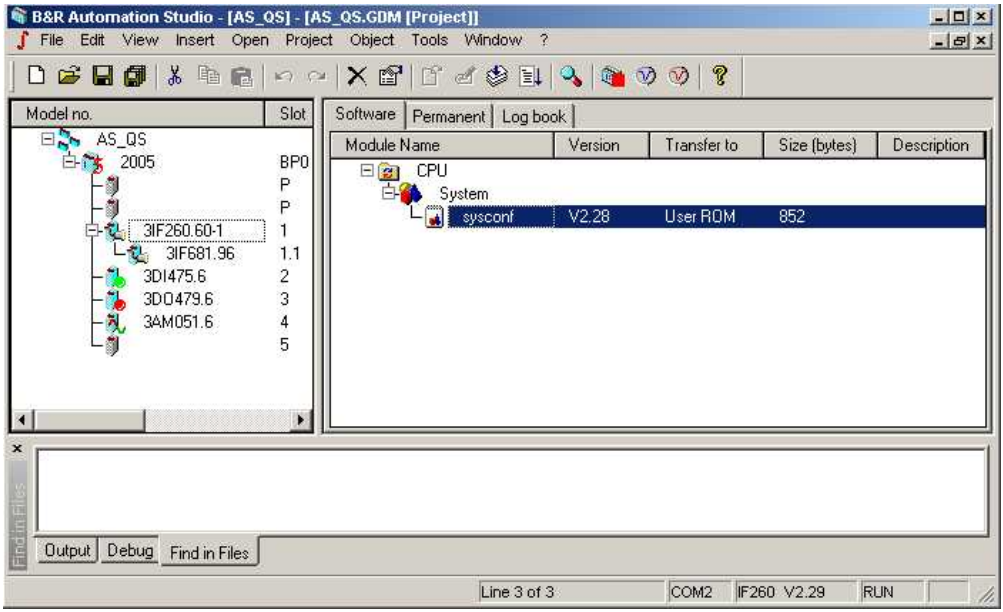


If a connection cannot be established even though the interface configuration is correct, check again to see if the B&R Automation Runtime™ operating system is installed on the controller! Have a look at "Chapter 3 −> How to create a project? −> Preparation").

Work environment

You probably noticed that the B&R Automation Studio™ main menu changes when you open a project. A "Project Window" is also opened.

The project window is the heart of each project. It is shown as a two part window:



The left section of the window gives an overview of the hardware used in the project (hardware configuration). The right section of the window provides additional information and settings for the marked module.

Left Window Section

The left section of the window gives an overview of the hardware used in the project.

The left section of the project window is called the **hardware configuration.**

The easiest way to define the hardware in a project is using automatic hardware recognition (see "Chapter 3 −> How to create a project? −> Creating a New Project"):

- When creating a new project, the user can let B&R Automation Studio™ upload the available hardware from the controller.
- If there is an active connection between the programming device and the target system, the current hardware on the target system is compared with the hardware configuration (shown in the project window).

If there are hardware differences, the modules in the current project that are different from the modules on the controller are marked:

Symbol	***Description***
	A **different module** is in this slot on the controller! You can replace the module by marking it and calling the context menu (right mouse button).
	No module is in this slot on the controller!

Right Window Section

The right section of the window contains additional information and settings for the module marked in the left section. The right section is divided into registers in order to show the information more clearly.

Which registers are shown depends on which module you have marked in the left section.

Register	***Description***
Software	This register card allows access to the software configuration (see below).
Logbook	This register card shows entries from the logbook on the PCC.

The software configuration is integrated in the right section of the project window. Each module that can run software (CPU or parallel processor) has a register card software. This register card is also called the software configuration.

You can configure the B&R Automation Runtime™ operating system performance to suit your application using the software configuration (you can find an in−depth description of the software configuration in the online help).

Register	***Description***
I/O	Module configuration: Displays all data points on the module. This list varies according to the properties of a module.

Variable declaration

We need the following process variables for our short example program (abbr. PVs):

key_1 ..... digital input
relay_1 ..... digital output

There are several ways to declare these two process variables. The variable declaration method shown on the following pages is the easiest for beginners.

Digital input

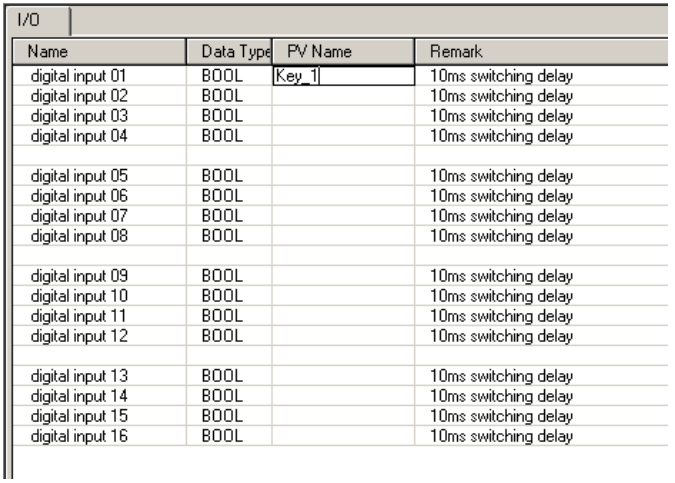
The digital input "key_1" can be defines as follows:

- In the left section of the project window, click on the symbol for the DI475 module (digital input module). The registers I/O is then shown in the right section of the window.
- If you click on the I/O register card, a list of all data points on the DI475 module is shown.
- To assign the variable name "key_1" to the first digital input on the DI475 module ...

  ... double click on the PV Name column in the first line of the list and enter the variable name "key_1". The entry for the variable name is completed when the **ENTER** key is pressed.

  ... place the cursor on the PV Name column in the first line of the list and press the SPACEBAR. Then you can enter the variable name "key_1". Press ENTER to complete the entry.

- Variable names can be up to 32 characters long.



- The Remark column normally contains a short function description for I/O on the module marked. You can enter an optional description with up to 34 characters in this column. To do this, double click on the Remark column and enter the desired text. Press ENTER to complete the entry.
  The additional description is only for documentation and is not transferred to the controller.

Digital output

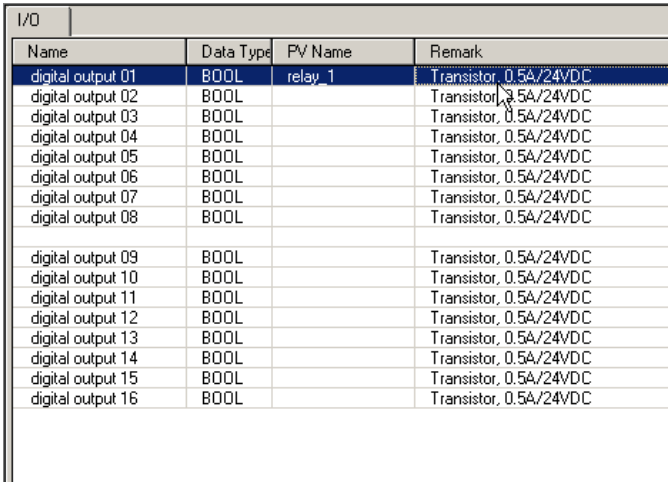
The digital output "relay_1" can be defines as follows:

- In the left section of the project window, click on the symbol for the DO479 module (digital output module). The registers I/O is then shown in the right section of the window.
- If you click on the I/O register card, a list of all data points on the DO479 module is shown.
- To assign the variable name "relay_1" to the first digital output on the DO479 module ...

  ... double click on the PV Name column in the first line of the list and enter the variable name "relay_1". The entry for the variable name is completed when the ENTER key is pressed.

  ... place the cursor on the PV Name column in the first line of the list and press the SPACEBAR. Then you can enter the variable name "relay_1". Press ENTER to complete the entry.

- Variable names can be up to 32 characters long.



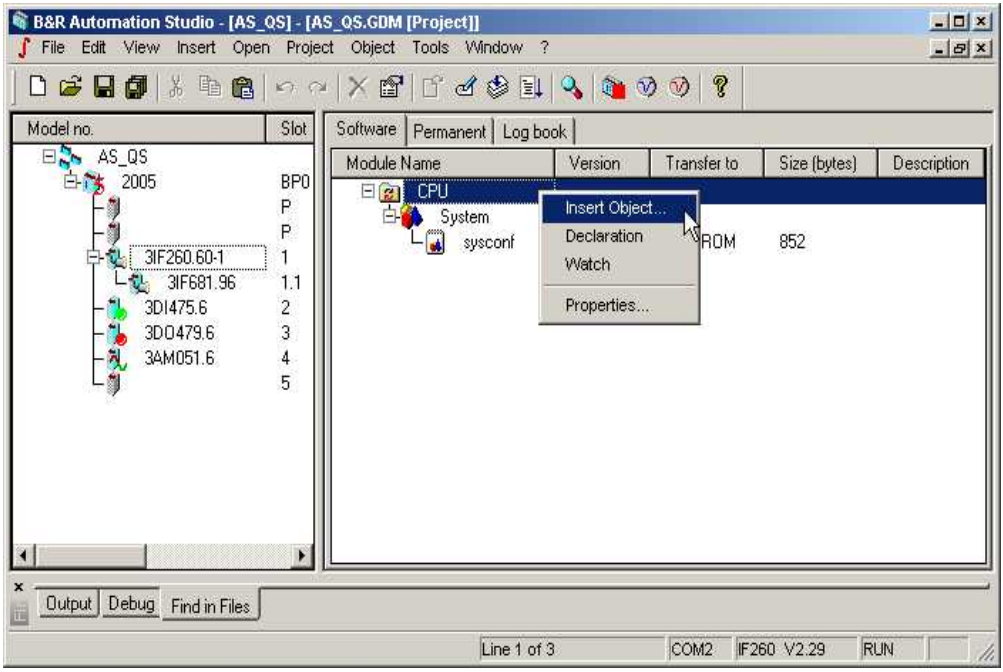
- The Remark column normally contains a short function description for I/O on the module marked. You can enter an optional description with up to 34 characters in this column. To do this, double click on the Remark column and enter the desired text. Press ENTER to complete the entry.
  The additional description is only for documentation and is not transferred to the controller.

Creating a cyclic object

Now we will enter our example program using the ladder diagram (LAD) programming language. We will create a cyclic object for the example program because it is to be processed cyclically.

Inserting a cyclic object

A cyclic object is inserted in the following manner:



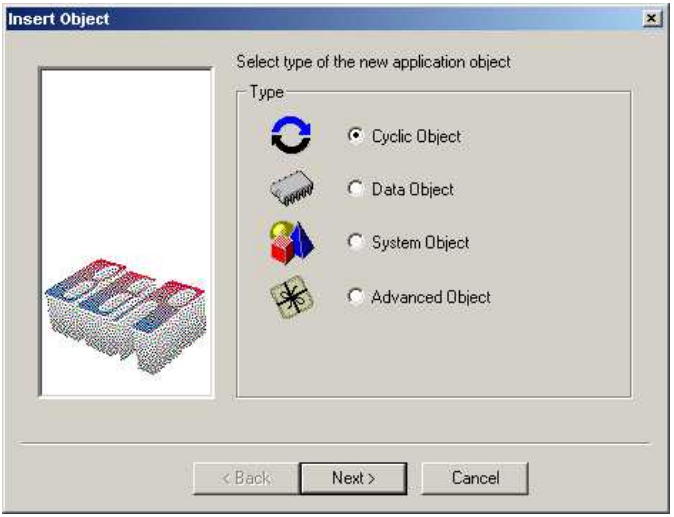
- In the left section of the project window, select a module that can contain a software object (CPU or PP). In our example, this is the IF260 module.
- Select the Software register in the right section of the window.
- Insert a new object by...

  ... clicking on New Object… in the Insert menu, or

  ... click on the CPU symbol with the right mouse button and select the Insert Object... command from the context menu shown, or

  ... click on the CPU symbol and then press the **INS** key.

- In the Insert Object dialog box shown, select resource type Cyclic Object and acknowledge the selection by pressing the **Next >** button.



Resource Types

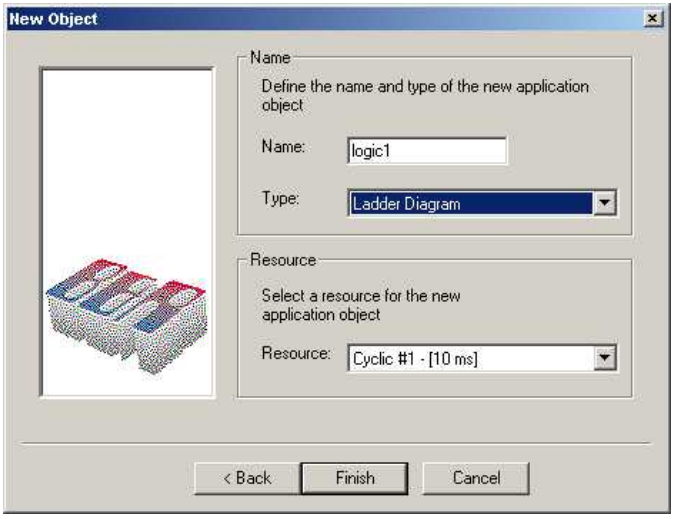
The following resource types can be selected from the dialog box Insert Object:

Resource	***Description***
Cyclic Object	A cyclic object is executed in a defined time frame (cycle time). The operating system monitors to make sure the cycle time is not exceeded. To assign priorities, cyclic objects can be assigned various resources (different cycle times). Cyclic objects that carry out important, time critical tasks are assigned a resource with a shorter cycle time and are therefore executed more often than objects assigned a resource with a longer cycle time. Cyclic objects include: • Cyclic objects • Timer objects • Interrupt objects • Exception objects
Non−Cyclic Object	This resource is deactivated as default because it is reserved for internal B&R functions (e.g. drivers).
Data Object	**Data objects** are modules used to store data.

System Object	B&R modules (*.BR files) can be transferred to the controller as system objects. System objects include libraries or objects with additional system functions. Many of these objects are loaded by B&R Automation Studio™ automatically and don't have to be inserted manually. **Library:** A collection of standard functions is represented in B&R Automation Studio™ by a B&R module (library). Each library contains functions that can save you time and effort solving standard problems. If a function from a library is used, that library is automatically imported into the project and installed on the controller during the next transfer.
Advanced Object	NC axes, CAM profiles, etc..

Define object name, object type and recourse

After defining the resource type in the Insert Object dialog box, the New Object dialog box used to define the object name, object type and resource is opened:



Enter the desired name in the Name field ("logic1" in our example) for the new object. Take note of the limitations for object names described in the context sensitive help! Then select Ladder Diagram for the object type (Type field) and Cyclic #1 − [10 ms] for the resource (Resource field).

You can assign various resources to object to define priority between the individual cyclic objects. A cycle time can be set for each cyclic resource and each timer resource.
All objects assigned this resource are executed once within this cycle time. Objects that carry out important, time critical tasks are assigned a resource with a shorter cycle time and are therefore executed more often than objects assigned a resource with a longer cycle time.

After acknowledging these entries by clicking on the **Finish** button, the cyclic object is entered in the software configuration and the LAD editor is opened.

Object Types

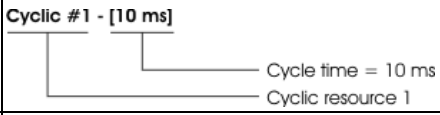
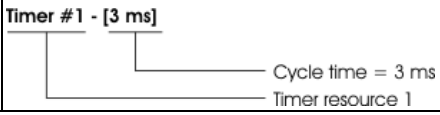
The following object types are presently possible for cyclic objects (see Type in the New Object dialog box):

B&R Automation Basic™	...	previously PL2000
C Program	...	ANSI C
Ladder Diagram	...	IEC 1131 Ladder Diagram (abbr.: LAD)
Sequential Function Chart	...	IEC 1131 Sequential Function Chart (abbr.: SFC)
Instruction List	...	IEC 1131 Instruction List (abbr.: IL)
Structured Text	...	IEC 1131 Structured Text (abbr.: ST)

Resources

The following resources are possible for cyclic objects (see Resource in the New Object dialog box):

Timed Resources

Resource	***Description***
Cyclic #x − [....ms]	Objects assigned this resource are executed cyclically. The B&R Automation Runtime™ operating system calls these objects. Cyclic resources have a fixed name (Cyclic) which the cycle time is added to (time for one cycle). Example: 
Timer #x − [....ms]	Objects with this resource are carried out cyclically using special hardware timers. Timer resources offer a high degree of consistency and have higher priority than cyclic resources. Timer resources have a fixed name (Timer) which the cycle time is added to (time for one cycle). Example: 

All resources described up to this point (cyclic resources and timer resources) are time controlled. However, there are also resources that are not time controlled, instead are carried out when a certain event occurs. We will differentiate between two types of event controlled resources: interrupt resource and exception resource.

Event Driven Resources

Resource	*Description*
Interrupt	Interrupts are asynchronous event (triggered by hardware) that interrupt cyclic program execution. Interrupts can only be generated by special hardware. An example of an interrupt capable module is the DI400 digital input module (B&R SYSTEM 2010). 8 digital inputs can be used as CSI inputs (CSI = "Change of State Interrupt") on this module. If the state of an enabled CSI input changes, an interrupt is triggered on the CPU. An object can be created for each interrupt capable module to handle the event.
Exception	Exceptions are signals that come from the B&R Automation Runtime™ operating system and indicate certain exception states. They can be compared to interrupts triggered by the system to indicate a fatal error. Objects which are assigned an exception resource, can be used to react to these fatal errors (e.g. inserting and removing I/O modules, power failure for RIO slave, etc.).

Entering the ladder diagram

Now we will program the circuit diagram (see "Chapter 3 −> Example Program −> Task Description") in the ladder diagram editor (abbr.: LAD Editor).

Inserting the Digital Inputs

Digital inputs can be inserted in the LAD editor as follows:

- Add a digital input symbol by ...

  ... clicking on in the toolbar, or

  ... pressing the C key, or

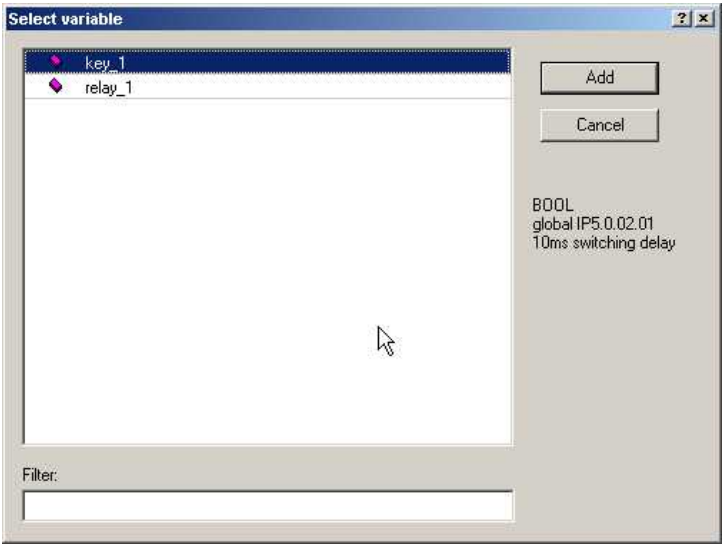
  ... clicking on the Contact command in the Insert menu and selecting Normally Open Contact from the submenu shown.

- Then assign the digital input "key_1" to the contact by ...

  ... entering the variable name "key_1" and pressing the ENTER key. or

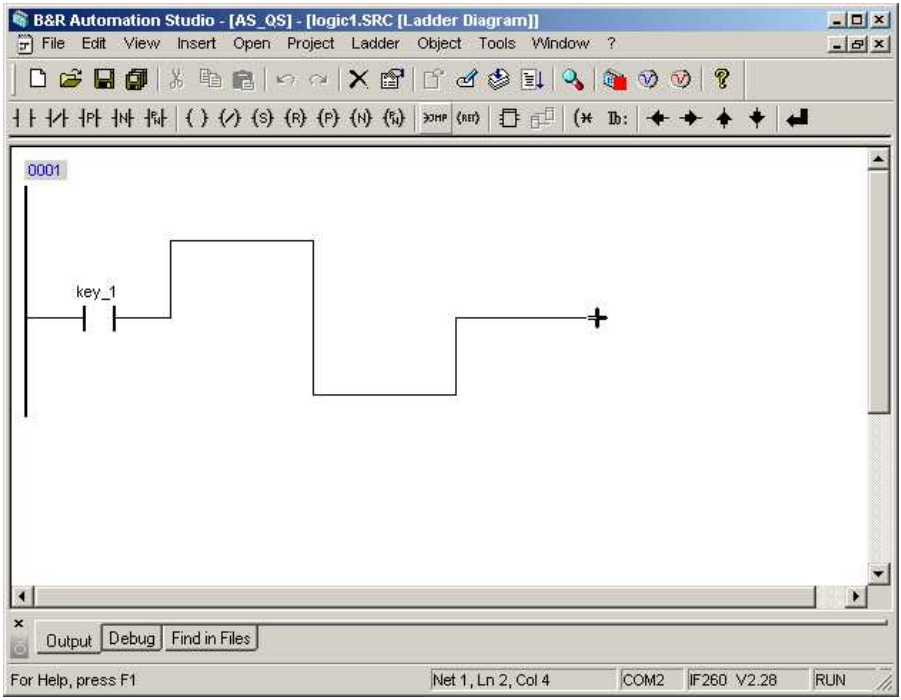
  ... pressing the SPACEBAR. Then a list of all defined process variables will be shown. Select "key_1" from this list and click on the

Add button.
The list only contains variables that are compatible with the data type of the new contact!



Drawing Connection Lines

Connection lines can be drawn using the key combination ALT+CURSOR KEYS or with the ←, →, ↑ and ↓ buttons.



Inserting the Digital Outputs

Digital outputs can be inserted in the LAD editor as follows:

- Add a digital output symbol by ...

... clicking on ( ) in the toolbar, or

... pressing the key combination SHIFT+C, or

... clicking on the Coil command in the Insert menu and selecting Coil from the submenu shown.

- Then assign the digital output "relay_1" to the contact by ...

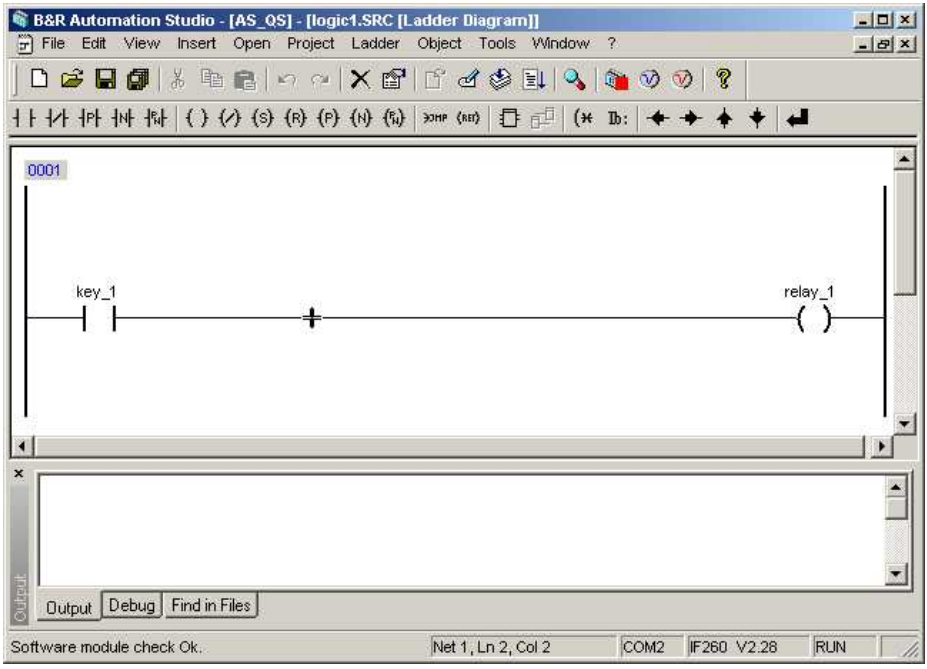
... entering the variable name "relay_1" and pressing the ENTER key. or

... pressing the SPACEBAR. Then a list of all defined process variables will be shown. Select "relay_1" from this list and click on the Add button.

The list only contains variables that are compatible with the data type of the new contact!

Checking and Optimizing LAD

If you click on the button in the toolbar or press the ENTER key, the ladder diagram is checked for open connection lines or other errors and optimized (extra connection lines are deleted, etc.). Check and optimize ladder diagram:



View Information On/Off

In the ladder diagram, it is possible to show additional information. The commands Type, Scope and Remark from the View menu and the context menu of the LAD editor (called with the right mouse button in the LAD editor) can be used to select which information is to be shown. A check to the left of the menu command means that this information will be shown.

Meaning of the additional information:

Information	***Description***
Type	Data type of process variables (detailed information concerning "data type" can be found in the online help).
Scope	Valid range of process variables (detailed information about the scope can be found in the online help).
Remark	Up to 34 character long description of the process variable (see "Chapter 3 −> Variable Declaration").

Saving and Closing LAD

To save the ladder diagram "logic1" on the programming device hard drive (D:\PROJECTS\AS_QS\...)

... click on the button in the toolbar, or

... press the key combination CTRL+S, or

... select the Save command from the File menu.

When saving, the ladder diagram is checked and optimized again. After saving, you can close the LAD editor.

Close the LAD editor by ...

... clicking on Exit in the File menu, or

... clicking on the button in the upper right corner of the LAD editor window.

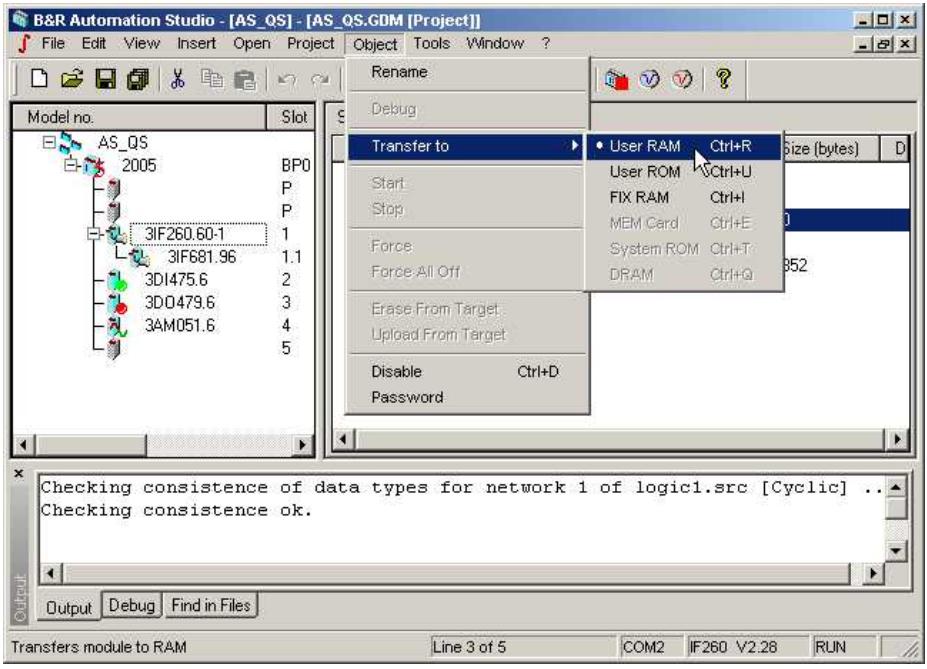
Compiling / transferring objects to the controller

The ladder diagram has to be converted to machine language for the processor on the controller. B&R Automation Studio™ has a compiler for this purpose. The compiler provides an executable program module (B&R module) in machine language for the processor.

Before compiling the example program "logic1" and transferring it to the controller, you have to define the memory area that will be used as target for object transfer.

Defining the memory area

To define the target memory area for the object "logic1", click on the object symbol in the software configuration and select the Transfer to command from the Object menu. A list of all memory areas possible for this object is shown:



Select the memory area User RAM from this list for the example program. Then the object will be stored in User RAM on the controller during transfer.

Overview of possible memory areas:

Memory Area	*Description*
User−RAM	User RAM is a conditionally nonvolatile memory area (buffered when power is not applied to the controller) and is available for application software (cyclic objects, data objects, etc.).
User−ROM	User ROM can be used to store cyclic objects, data objects, etc. in nonvolatile memory. User ROM is in the form of a Flash PROM.
FIX−RAM	Using B&R Automation Studio™ (software configuration), you can configure a part of User RAM to behave like User ROM during a COLD RESTART. This memory area is called FIX RAM. Objects stored in FIX RAM are not deleted during a COLD RESTART. COLD RESTART boot mode corresponds to the first time a processor is initialized. The operating system is restarted and all RAM data (except objects stored in FIX RAM) is deleted.
MEM−Card	Some processor modules can be equipped with a PCMCIA memory card (also called MEM card). The MEM card can be used to store cyclic objects, data objects, etc. in nonvolatile memory. That means this memory corresponds to either the User ROM (MEM Card as Flash PROM) or FIX RAM (MEM Card as SRAM).
SYS−ROM	The operating system B&R Automation Runtime™ is stored in System ROM. System ROM is a nonvolatile memory area in the form of a Flash PROM.
DRAM	The object is stored directly in DRAM when transferred to the controller. DRAM is a nonvolatile memory area and is available for application software (cyclic objects, data objects, etc.).

Compile and transfer

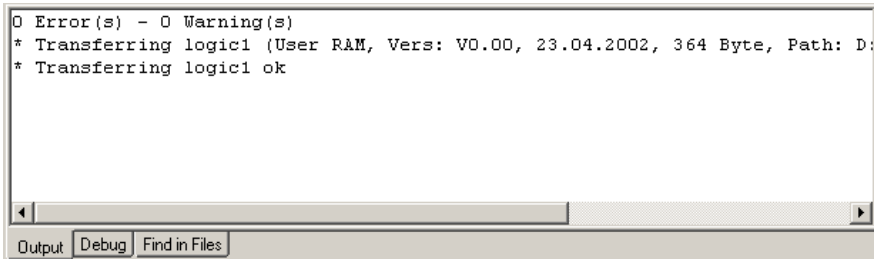
To compile the example program and transfer it to User RAM, ...

... click on the button in the toolbar, or

... select the Transfer to Target command from the Project menu.

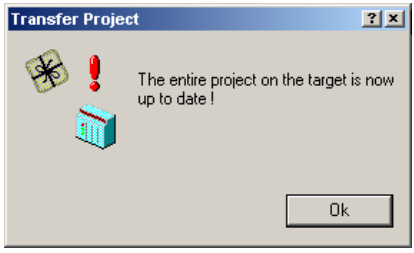
Using this command, the entire project is compiled and then the objects are transferred to the defined memory area and started.

The progress and completion status of the compile procedure is shown in the message window:


0 Error(s) - 0 Warning(s)
* Transferring logic1 (User RAM, Vers: V0.00, 23.04.2002, 364 Byte, Path: D:
* Transferring logic1 ok
Output
Debug
Find in Files

To avoid errors, B&R Automation Studio™ checks the structure of the target system hardware, the version of the operating system and all previously installed software objects during transfer. Known problems will be clearly pointed out so that additional errors can be avoided.

The following message is given after the project has been successfully transferred:



The example program is now running in User RAM. The digital output is set or reset according to the logical state of the digital input.

Testing the object

B&R Automation Studio™ recognizes many problems during programming and indicates them using compiler messages, however it is necessary to have a comfortable debugger for large projects. Therefore powerful diagnostics tools are integrated in B&R Automation Studio™.

LAD monitor

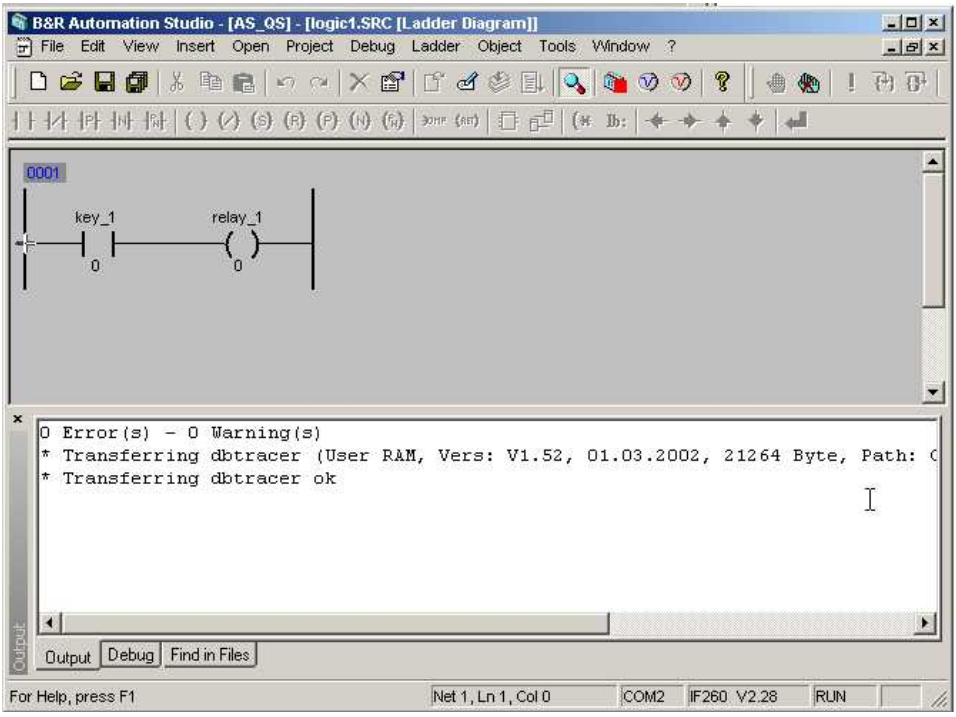
With the Ladder Diagram Monitor (LAD monitor), it is possible show and force process variables from a ladder diagram running on the controller directly in the ladder diagram mask.

To open the LAD Monitor, you have to first open the LAD Editor. To do this, double−click on the symbol for example program "logic1" in the software configuration. You can then open the LAD monitor from the LAD editor by ...

... clicking on in the toolbar, or

... entering the key combination CTRL+M, or

... selecting the Monitor command in the View menu.



Forcing a Variable

Using the Force function in the LAD monitor, you can change the state of digital inputs from B&R Automation Studio™. This function can be used to test the example program "logic1".

If a process variable is forced, it is assigned a specific value and remains at this value. If an object writes to a forced process variable, the changed value is only valid for the current cycle. Then the variable is overwritten with the force value entered.
The Force Function is also available in other B&R Automation Studio™ diagnostics tools.

To force the variable "key_1", click on the symbol for the digital input "key_1" with the right mouse button and select Force from the context menu shown.

Then a dialog box is shown asking if the variable should be forced. Answer this question with OK.

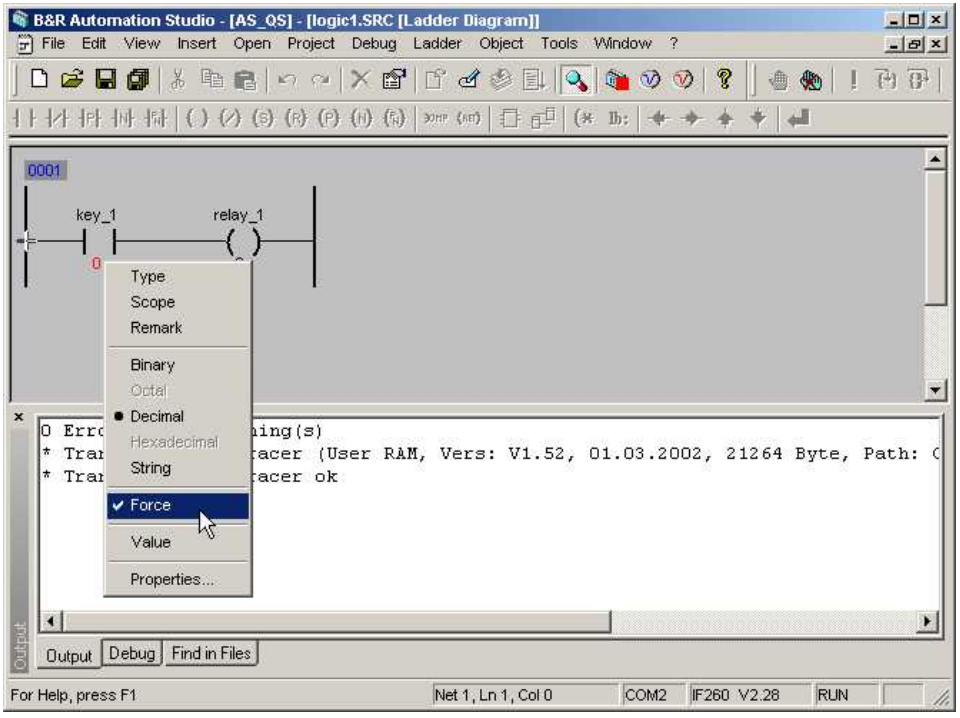
A check mark to the left of the Force menu item in the shortcut menu means that the variable is forced! The values of forced variables are also shown in red in the LAD monitor.

Then you can set the value of the digital input "key_1" to 1, by ...

... clicking on the symbol for the digital input with the right mouse button again and selecting Value from the context menu. The value "1" can now be entered. Press ENTER to complete the entry.

... click on the symbol for the digital input and press the SPACEBAR. The value "1" can now be entered. Press ENTER to complete the entry.

This causes the digital output "relay_1" to be set:



Closing the LAD Monitor

Close the LAD monitor by ...

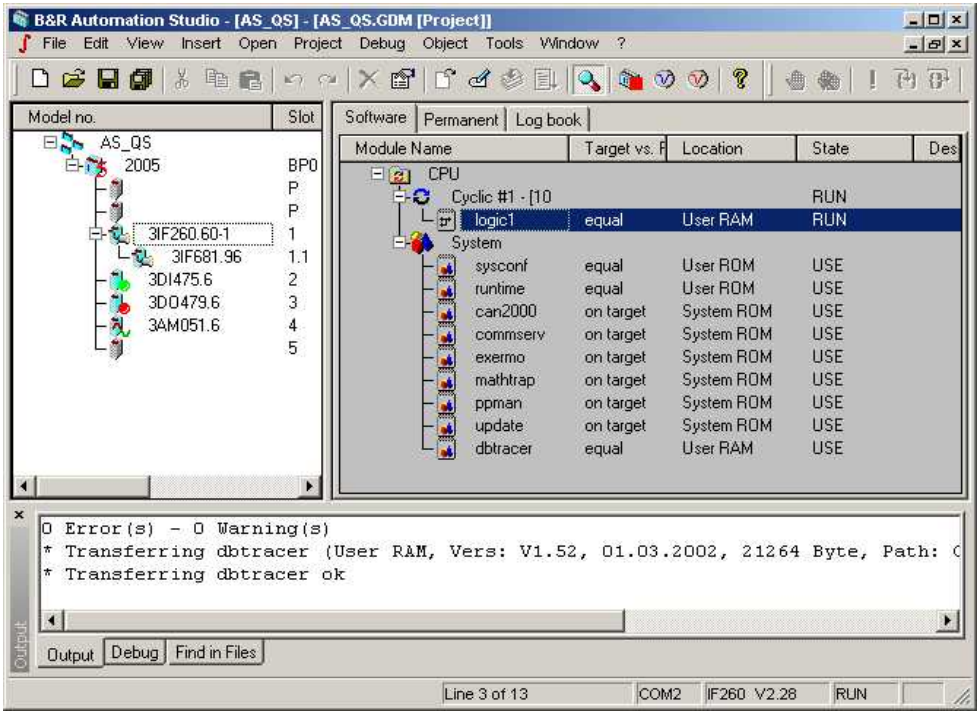
... clicking on Exit in the File menu, or

... clicking on in the upper right corner of the LAD monitor window.

Additional information concerning "LAD Monitor" can be found in the B&R Automation Studio™ online help.

System monitor

When you close the LAD monitor window, B&R Automation Studio™ remains in monitor mode. The System Monitor (System Monitor = software configuration in monitor mode) is shown:



To turn monitor mode on or off, ...

... click on the button in the toolbar, or

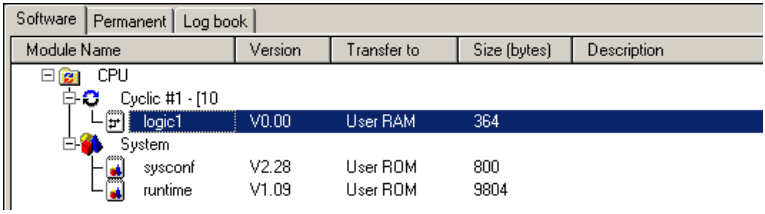
... enter the key combination CTRL + M, or

... select the Monitor command from the View menu.

Different information is shown in the software configuration depending on if B&R Automation Studio™ is in monitor mode or not.

Monitor Mode Turned Off

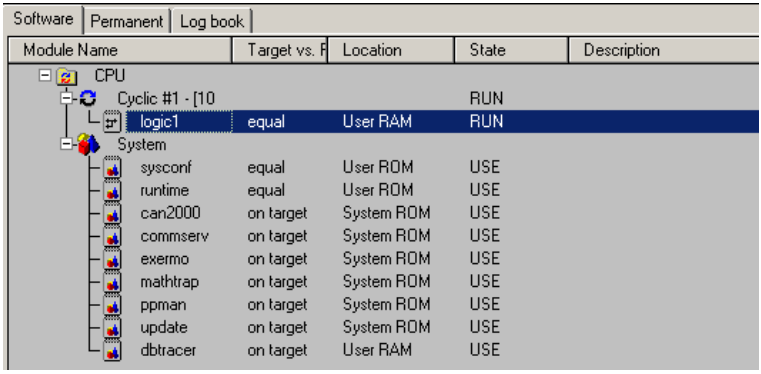
In this mode, all objects in the current project are shown. Objects only found on the controller are not shown in this mode. The following information is shown in the right section of the project window:



Column	*Description*
Module name	Symbol and name of the software object.
Version	Version number of the software object.
Transfer to	Target memory for the software object (valid for the next transfer).
Size (bytes)	Size of the compiled software object in bytes. If the object has not been compiled, the value 0 is shown.

Monitor Mode Turned On

In this view, the differences between the current project (computer) and the controller are shown. The following information is provided in addition to the symbol and name of an object:



Column	***Description***
Module Name	Symbol and name of the software object.
Target vs. Project	Objects in the project and on the controller are compared and the result is shown: • on target only.....Object is only on the controller (target system). • not on target.....Object is not on the controller (only in project). • older on target .....Object in the project is more current than the one on the controller. • newer on target .....Object on the controller is more current than the one in the project. • equal.....Object in the project and on the controller are identical.
Location	Memory where the object can be found on the controller.
State	State of the object. The status of cyclic objects (cyclic objects, timer objects, interrupt and exception objects) and idle time objects: • **RUN** Software object being executed. • **STOP** Software object stopped (NOT being executed). The status of the system and data objects:

	• **RDY** The software object (system or data object) is ready to be used by other objects. • **USE** The software object (system or data object) is being used by other objects.

Additional information concerning "System Monitor" can be found in the B&R Automation Studio™ online help.

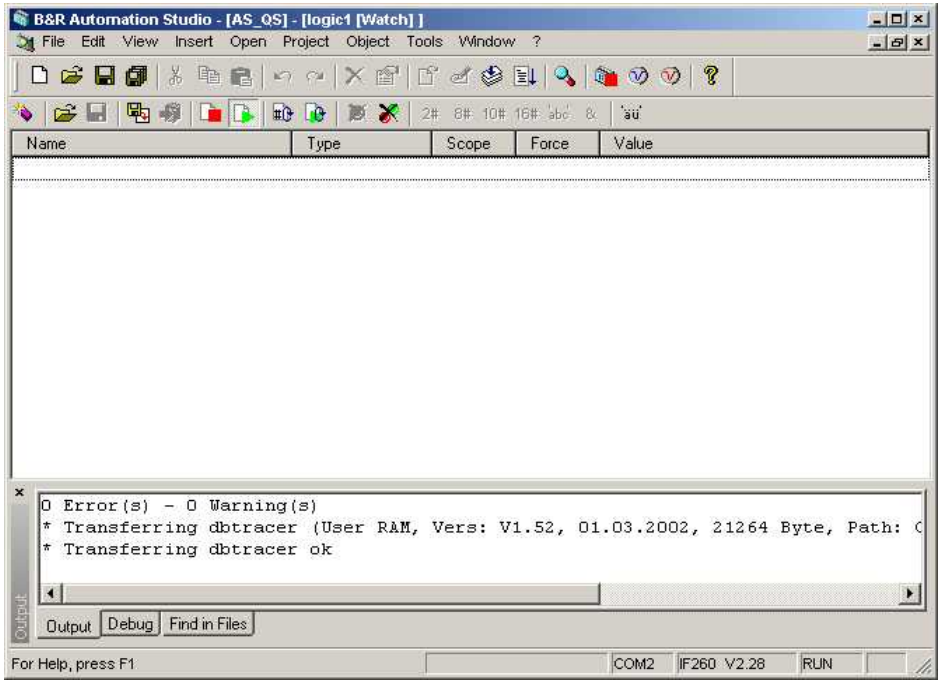
Watch

Using the Watch Function, you can view, monitor and change the values of process variables found on the controller. Open the watch window for the object "logic1" by...

... clicking on the symbol "logic1" in the software configuration and selecting the Watch command in the Open menu, or

... clicking on the symbol "logic1" with the right mouse button in the software configuration and selecting the Watch command from the context menu shown.

The following information is shown in the watch window:



Column	*Description*
Name	Names of process variables are shown in this column.
Type	The data type of each variable is shown in this column. The data type defines the memory requirements and value range for a process variable (detailed information can be found in the online help).
Scope	The user can define the scope of the variable in a drop down box. The scope is predefined as **global** in the global editor. The declaration can be called in such a way that it relates only to an object. Only variables used within this object are displayed. For objects the scope of variables can also be defined as **local**. An object−specific declaration is called if ... • ... the editor of an object is open and the window is in the foreground (e.g. LAD editor open). • ... an object (e.g. LAD object) is selected in the software configuration. The drop down box is called by double−clicking or by pressing the spacebar.

<table>
<tr><td></td><td>Use the mouse or cursor keys to make the selection.</td></tr>
<tr><td>Force</td><td>The following information is shown in this column:
<table>
<tr><th>Symbol</th><th>Description</th><th>Force Status</th></tr>
<tr><td> </td><td>Force symbol for input (green)</td><td>not active</td></tr>
<tr><td> </td><td>Force symbol for input (green)</td><td>active</td></tr>
<tr><td> </td><td>Force symbol for output (red)</td><td>not active</td></tr>
<tr><td> </td><td>Force symbol for output (red)</td><td>active</td></tr>
<tr><td>No Symbol</td><td>Variable in memory</td><td>__</td></tr>
</table></td></tr>
<tr><td>Value</td><td>The value of variables is shown in this column. You can select from several view formats:

• binary
• octal
• decimal
• hexadecimal
• string

The commands Binary, Octal, Decimal, Hexadecimal and String in the View menu and in the shortcut menu for the watch window (called with the right mouse button in the watch window) can be used to select the view format. A dot • to the left of the menu item means that the variable values will be displayed in this format.</td></tr>
</table>

Inserting a Variable

All functions in the watch window refer to the software object that was marked in the software configuration when the watch function was called. That means you can only insert variables that exist in the selected object.

You can insert a variable in the watch window as follows:

- The watch window has to be the active window!
- Insert a new variable by...

... clicking on in the toolbar, or

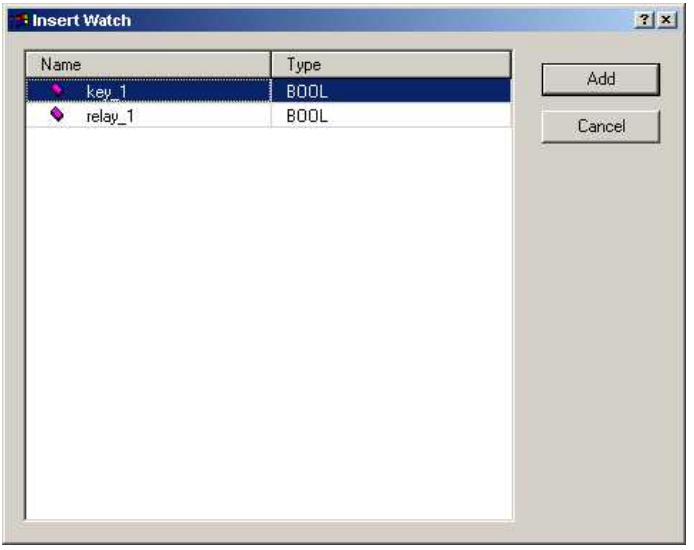
... pressing **INS** and then the **SPACEBAR**, or

... clicking on **Variable** in the **Insert** menu, or

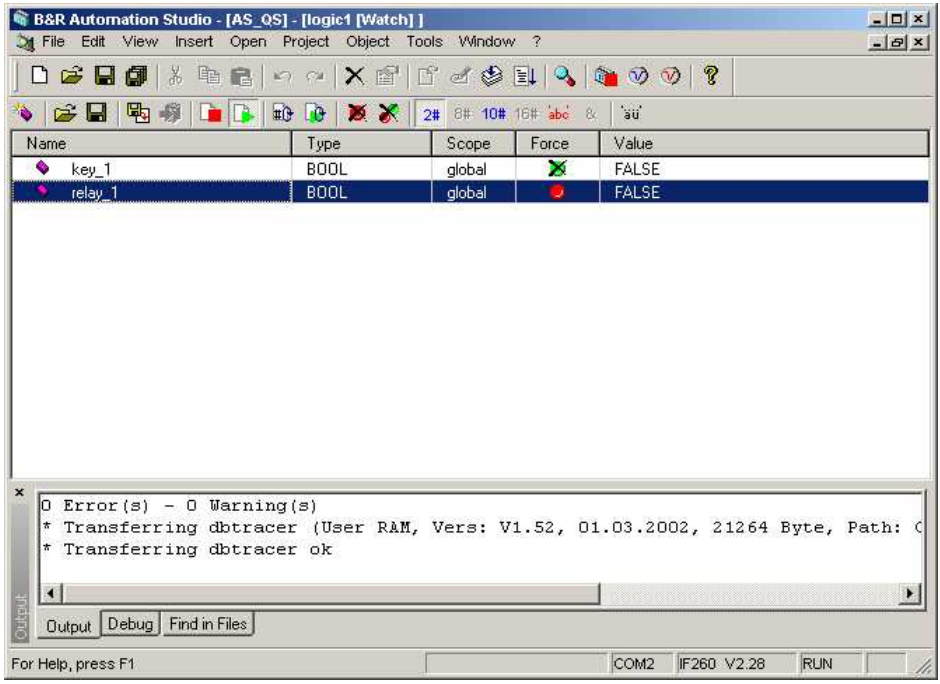
... clicking in the watch window with the right mouse button and select the **Insert Variable** command in the context menu shown.

- Select the desired variable (e.g. "key_1") in the Insert Watch dialog box and click then press the **Add button**.

You can also select several variable at the same time in the Insert Watch dialog box and insert them into the watch window. To do this, press and hold SHIFT when selecting the variables (with the mouse or CURSOR key):



After closing the dialog box by pressing the Add button, all marked variables are inserted into the watch window:


B&R Automation Studio - [AS_QS] - [logic1 [Watch]]
File Edit View Insert Open Project Object Tools Window ?
Name Type Scope Force Value
key_1 BOOL global FALSE
relay_1 BOOL global FALSE
0 Error(s) - 0 Warning(s)
* Transferring dbtracer (User RAM, Vers: V1.52, 01.03.2002, 21264 Byte, Path: C
* Transferring dbtracer ok
Output
Output Debug Find in Files
For Help, press F1
COM2 IF260 V2.28 RUN

Editing a Variable

You can change the value of a variable as follows:

- Mark a variable in the watch window.
- Change the value of this variable by ...

... pressing the SPACEBAR (the cursor has to be in the Value column) and entering the desired value, or

... clicking on Variable in the Edit menu and entering the desired value, or

... entering the desired value directly (the cursor has to be in the Value column).

- Press ENTER to accept the new value or ESC to disregard the change.

If the variable to be changed is an input or output as with our example (digital input "key_1" or digital output "relay_1"), the variable is **automatically** forced after acknowledgement.

Activating/Deactivating Force Status

The force status of a variable can be activated manually.

To activate the force status of a variable, mark the variable in the Watch window and ...

... click on the button in the toolbar, or

... click on Force in the Object menu or

... click on Force in the shortcut menu (called with the right mouse button)

Then a dialog box is shown asking if the variable should be forced. Answer this question with OK..

A check mark to the left of the Force menu item in the Object menu and in the shortcut menu means that the variable is forced! The following symbols in the Force column of the watch window also indicate a forced variable:

Symbol	*Description*	*Force Status*
	Force symbol for input (green)	active
	Force symbol for output (red) active	active

To deactivate the force status of a variable, mark it in the watch window and click on Force again in the Object menu or shortcut menu (called with the right mouse button). Then a dialog box is shown asking if the process variable should be forced. Answer this question with OK.

If you want to deactivate the force status of all variables in the watch window at the same time, click on the button in the toolbar or on Force All Off in the Object menu.

Closing the Watch Window

Close the watch window by ...

... clicking on Exit in the File menu, or

... clicking on in the upper right corner of the watch window.

Additional information concerning all functions of the watch window can be found in the B&R Automation Studio™ online help.

Appendix A − Frequently Asked Question

How to install the operating system?

The B&R Automation Runtime™ operating system is stored in System ROM on the processor (CPU or PP).

System ROM is a nonvolatile memory area in the form of a Flash PROM.

You can download or update the B&R Automation Runtime™ operating system yourself using B&R Automation Studio™.

The operating system download or update is described for each module in the respective hardware user's manual. You can also look in the module description integrated in B&R Automation Studio™.
Please note the switch settings for bootstrap loader mode or RUN mode listed there.

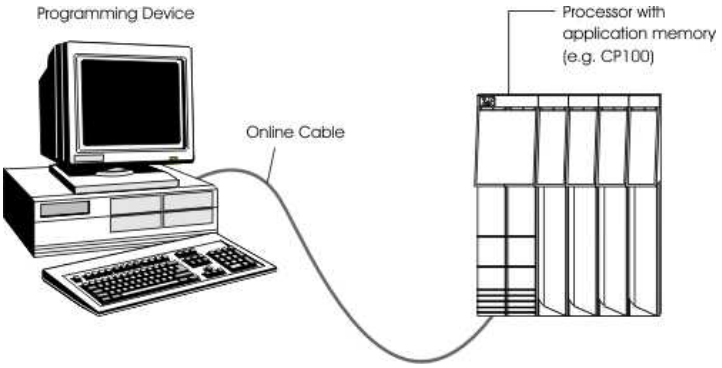
Processors with application memory

Application memory is always delivered without an operating system installed. The first operating system installation (operating system download) can be carried out as follows for processors with application memory (B&R SYSTEM 2010 CPUs CP10x and CP200/CP210):

1. Turn off power to the controller. This is necessary because the application memory is only allowed to be removed or inserted without power applied!

2. Insert new Flash PROM application memory and return power.
Make sure that the write protect switch on the front of the application memory is on the write position!

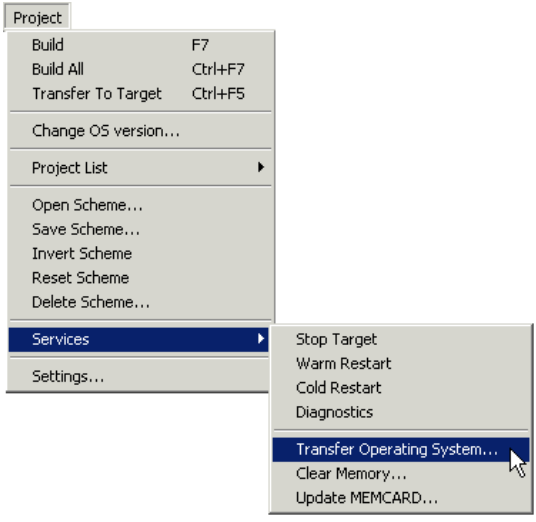
3. Take the online cable and connect the computer to the CPU where the operating system should be installed.



4. Start B&R Automation Studio™.

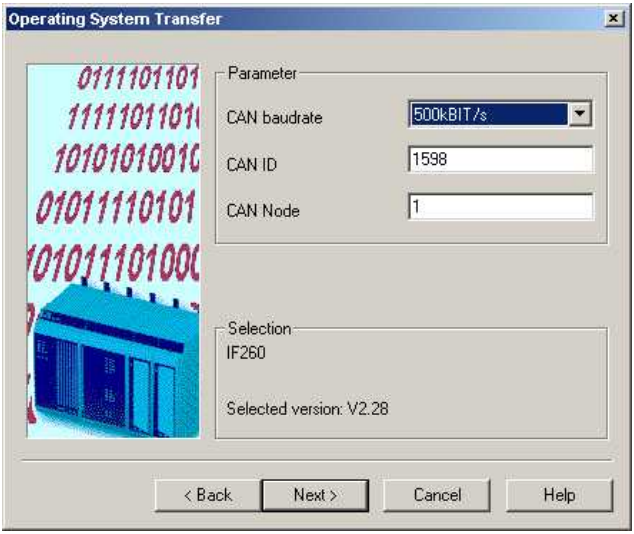
5. Then open a project in B&R Automation Studio™. To do this, select **Open Project...** from the **File** menu.

6. Start the download procedure by calling the Services command from the **Project** menu. Select
Transfer Operating System... from the menu shown.



7. B&R Automation Studio™ now gathers all information required for the operating system download (type and revision of the application memory, etc.) from the controller. Then a dialog box will be opened where you can define a few CAN

parameters (baud rate, CAN identifier and CAN node number):



8. The default settings in this dialog box only has to changed if your controller is in a CAN network that requires other settings!

9. Selecting the **"<Back"** button causes a dialog box to be shown where you can select the interface used on your computer for the connection to the target system (e.g. COM2) and the desired operating system version (e.g. V2.28).
With **"Next>"**, you can return to the dialog box used to define the CAN parameters.

The dialog box used to define the interface and the operating system version can also be shown first. This is the case if e.g. an connection is not made. The respective PC interface can then be selected. Afterwards the operating system has to be selected in the BR Automation System directory (abbr. ...\AS\System\V0228\m68k). The connection to the target will be carried out automatically and the CAN properties dialog opens.

10. After closing the CAN parameter dialog box by pressing **"Next>"**, the Flash PROM is deleted. Then the selected version of the operating system is downloaded to Flash PROM. Download progress is shown on the screen. The download procedure can take a few minutes!

11. The controller is now ready for operation.

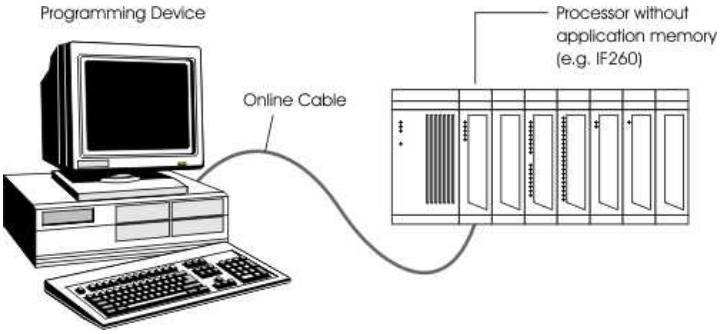
If the update procedure is interrupted, the installation of the operating system has to be started again.

Processors without application memory

An operating system is already installed during delivery for processors without application memory (CP260, CP360, IF260, IP161, XP152, CP430, CP47x, CP77x, AR102, AR105, ARxxx).

Updating the operating system is only possible in RUN Mode. The RUN Mode settings can be found in the hardware documentation. The following steps are necessary for an operating system update:

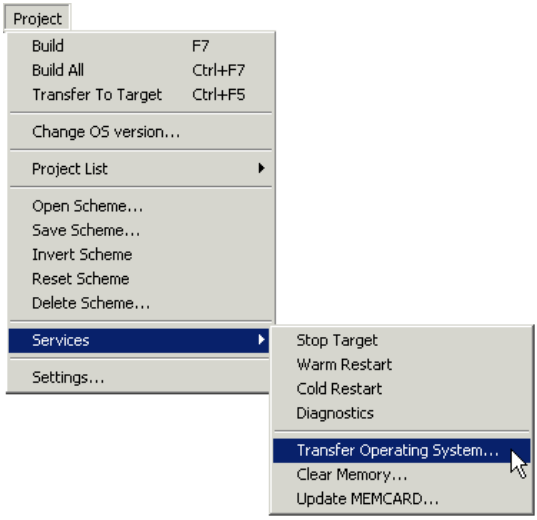
1. Take the online cable and connect the computer to the processor (CPU or PP) where the operating system should be updated.



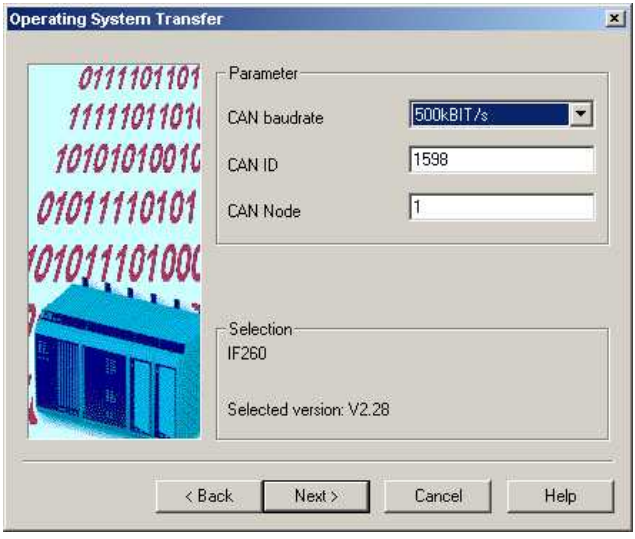
2. Start B&R Automation Studio™.

3. Then open a project in B&R Automation Studio™. To do this, select **Open Project...** from the **File** menu.

4. Start the download procedure by calling the Services command from the Project menu. Select **Transfer Operating System...** from the menu shown.

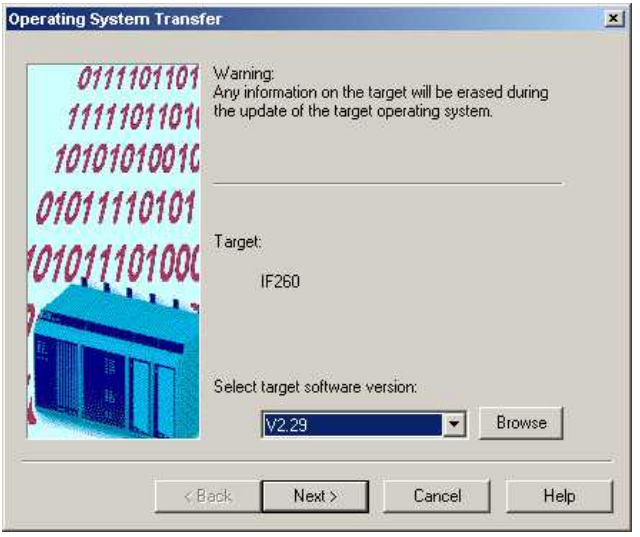


5. B&R Automation Studio™ now gathers all information required for the operating system download (type and revision of the processor module, etc.) from the controller. Then a dialog box will be opened where you can define a few CAN parameters (baud rate, CAN identifier and CAN node number):



6. The default settings in this dialog box only has to changed if your controller is in a CAN network that requires other settings!

7. Selecting the **"<Back"** button causes a dialog box to be shown where you can select the desired operating system version (e.g. V2.25). With **"Next>"**, you can return to the dialog box used to define the CAN parameters.



8. After closing the CAN parameter dialog box by pressing Next, the Flash PROM is deleted. Then the selected version of the operating system is downloaded to Flash PROM. Download progress is shown on the screen. The download procedure can take a few minutes!

9. The controller is now ready for operation.

If the update procedure is interrupted, the installation of the operating system has to be started again.

How can I work without hardware?

B&R Automation Studio™ is a hardware oriented programming system. That means the hardware has to be defined when creating a project. We differentiate between Automatic Hardware Recognition and **Manual Hardware Definition**.

If you want to work without hardware, you have to use manual hardware definition when creating a project.

Manual hardware definition

A detailed description of the steps required for manual hardware definition can be found in (see "Chapter 3 −> How to create a project −> Creating a New Project").

If the target system hardware is not available, the programming device can work OFFLINE (no connection between computer and controller).

Define additional modules

After creating a project, additional modules can be defined in the left section of the project window (e.g. digital or analog I/O modules). This is done as follows:

- In the hardware configuration, place the cursor on the position where you want to insert the module.
- Insert a new module by...

... clicking on **Module…** in the **Insert** menu, or

... pressing the INS key.

- Select the desired module in the Select Module dialog box.
- Acknowledge your selection by pressing the OK button.

You can create any hardware configuration by simply repeating this procedures for all desired modules. Then you can declare variables, create objects, etc.

Take note that you can program a project without hardware, but you can't test it!

Is multiple installation of B&R Automation Studio possible?

Multiple installation of B&R Automation Studio is possible beginning with V2.2. Changing to different versions takes place by using the Version Changer. However, only one version at a time can be active.

Older B&R Automation Studio versions have had their installation programs modified (as far back as V1.4.1) so that they can also be installed alongside newer versions.

Installing the Version Changer

The Version Changer must be installed on your system before it can be selected from the Start Menu. To do this, run 'BrMenu.exe' from the root directory of your installation CD.

The following dialog box opens:

B&R Automation Installation
Available Setup Sets:
CD Contents & Setup information [English]
Automation Studio V 2.2.0.15 [English]
Automation Net (PVI) V 2.2.0.15 [English]
AR010 Installation V 2.60 [English]
AR102 Installation Kit V 2.60 [English]
AR105 Installation Kit V 2.60 [English]
Windows CE Installation Kits B 1.7.0.17 [English]
Panel Studio V 1.3.4 [English]
MTC & Mkey Utilities B 1.00 [English]
Automation Studio Version Changer [English]
Internet Explorer 5.0 [English]
Acrobat Reader 5.0 [English]
Start
Close

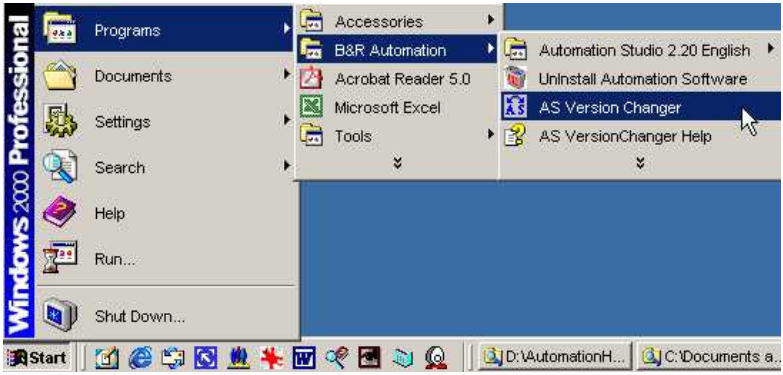
Select 'Automation Studio Version Changer' and begin the installation procedure by clicking on the 'Start' button.

Menus will lead you through the installation process. If installation is successful, then the Version Changer is displayed under 'B&R Automation' in the Start Menu.

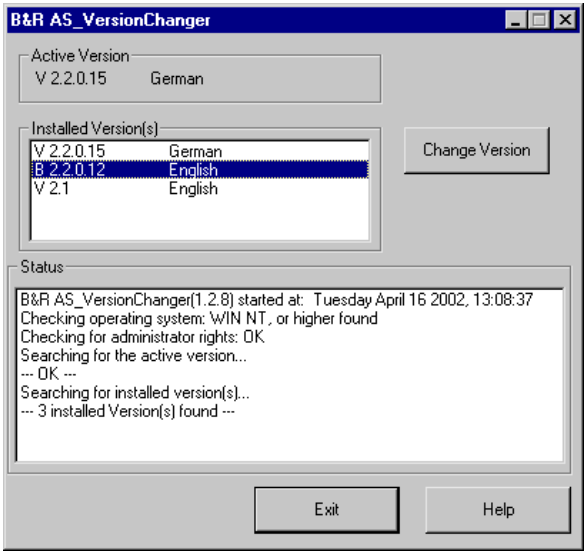
Switching Procedure

If several versions are installed at one time, the Version Changer can be used to switch between them.

Start the Version Changer from the Start Menu:



The dialog box which appears displays the active version by highlighting it. The up/down cursor keys can be used to highlight the version which should now be used. Pressing the 'Change Version' switches the highlighted version active. This process can take a few seconds.



The 'Exit' button can be used to leave this dialog box.

Appendix B − Key Combinations

Key combinations for command calls

Key Combinations	*Description*
General	
+/−	Trees can be opened and closed using the + and – keys on the number block. As an alternative to the number block keys, CTRL+− and CTRL++ can be used on the normal keyboard.
ENTER	Opens the respective editor in the software configuration or closes the dialog box using the highlighted button (mostly OK).
ALT+ENTER	With ALT+ENTER, you can enter the respective properties dialog box.
ESC	Cancels entries and dialog boxes.
F1	Opens context sensitive help.
F4	Open selection boxes (e.g. selection box for task class in the properties dialog box for tasks).
CTRL+F4	Close current editor window.
ALT+F4	Close B&R Automation Studio™.
F6	Switch between left and right panes of the project window.
CTRL+F6	Switch between the individual editor windows, as alternative to CTRL+TAB.
SHIFT+CTRL+F6	Like CTRL+F6 but in then other direction, as alternative to SHIFT+CTRL+TAB.
SHIFT+F10	Opens the respective shortcut menu (like the right mouse button), SHORTCUT KEY can also be used (to the left of the right CTRL KEY on a Win95 keyboard).
ALT+SPACEBAR	Opens the system menu in the AS window.
ALT+−	Opens the system menu in the respective editor window.
INS	Inserts a new element in a table, the new element is inserted above the current cursor position.

CTRL+INS	If several hierarchies of elements exist in a table or an editor (main and sub−elements), the main elements are to be created with CTRL+INS and the sub−elements with INS. If the cursor is on a main element, the sub−element is inserted as the last element in the list below the main element.
DEL	Deletes the currently marked object.
SPACEBAR	With the SPACEBAR, the currently marked cell in a table goes into entry mode. In a cell that is already in entry mode, the SPACEBAR in is used to go to a selection dialog box (if available).
CTRL+D	Disables the object currently marked by the cursor.
CTRL+R	Target memory of the software object is User RAM.
CTRL+U	Target memory of the software object is User ROM.
CTRL+I	Target memory of the software object is FIX RAM.
CTRL+E	Target memory of the software object is a MEM Card.
CTRL+T	Target memory of the software object is SYSTEM ROM.
CTRL+X	Cut the currently marked block to the clipboard.
CTRL+C	Copy the currently marked block to the clipboard.
CTRL+V	Paste a block from the clipboard.
CTRL+Z	Undo the last action.
CTRL+Y	Redo the last undo action.
CTRL+S	Save
CTRL+P	Print
CTRL+F	Calls the Find dialog box.
CTRL+H	Calls the Replace dialog box.

CTRL+G	Calls the Goto function.
CTRL+W	Opens the PV Monitor.
Desktop	
CTRL+O	Open a project.
CTRL+N	Create a new project.
CTRL+M	Activates monitor mode.
ALT+0	Switches to the project window.
ALT+1	Places focus on the message window (docked under the main window).
F4	Jumps to the next message in the message window. Either the next error message or the next result from "Edit −> Find in Files" depending on which register is active in the message window.
SHIFT+F4	Jumps to the previous message in the message window.
Text Editors	
F3	Continue search in the forward direction.
SHIFT+F3	Continue search in the reverse direction.
Build & Transfer	
CTRL+F5	Transfer to PCC.
F7	Build
CTRL+F7	Build all
Debugger	
F5	Continue
SHIFT+F5	Cancel Debugger, allow task to continue.
F9	Set breakpoint

SHIFT+F9	Show breakpoint
F11	Step into
F10	Step over
LAD Editor	
Key combinations for LAD editor can be found in the toolbar quick info or next to the menu items.	